Remedial Investigation
Health and Safety Plan

Glen Cove
Former Manufactured Gas Plant Site
Glen Cove, New York

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SUBMITTED TO

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1. Introduction

This Health and Safety Plan (HASP) addresses the health and safety practices that will be employed by all site workers participating in the Remedial Investigation (RI) to be conducted at a former manufactured gas plant (MGP) located in Glen Cove, New York. The former MGP was once owned by KeySpan Energy's predecessor, Long Island Lighting Company (LILCO), prior to being demolished in the early 1929. The Glen Cove former MGP operated from circa 1904 through 1929. After that, the site was utilized for gas storage from 1929 through circa 1950. The site has subsequently been redeveloped into a transformer substation. Figure 1 shows the regional location of the site. Figure 2 depicts the current site conditions and historic structures.

This HASP takes into account the specific hazards inherent to the project and presents detailed procedures to be followed by GEI Consultants, Inc., (GEI) personnel, and both GEI and KeySpan subcontractors. All activities performed under this HASP will comply with Occupational Safety and Health Administration (OSHA) Regulations 29 CFR Part 1910 and 1926, and all other applicable federal, state, and local regulations.

The RI Work Plan outlines the operations to be performed at the site. This HASP is applicable to all project operations, including the following.

- Air monitoring
- Surface and subsurface soil sampling
- Soil borings, monitoring well installation, and well development
- Groundwater sampling and hydraulic conductivity testing
- Contaminated soil/material handling and transport activities
- Site survey
- Other work as applicable

The RI Work Plan outlines the operations to be performed at the site. Specific health and safety measures applicable to these activities are provided for in this HASP. Included in this HASP are four general sections covering the Medical Surveillance Program, Emergency Support and Procedures, Training Programs, and the Site Safety Plan. The Site Safety Plan has been prepared such that it can be separated from this HASP and posted at the site for general use. Reading of the Site Safety Plan is required of all on-site GEI and KeySpan personnel as well as subcontractors.

The Site Safety Officer (SSO) has final authority regarding health and safety matters for all GEI personnel and project subcontractors while on the project site, including but not necessarily limited to drilling contractors, excavation contractors, or construction personnel.

The GEI Field Team Leader is the designated SSO for the Glen Cove former MGP RI project. Henceforth, SSO will refer to the Field Team Leader or his/her designee.

This HASP will be updated as appropriate if additional information is obtained regarding the health and safety risks of materials/wastes being handled, or if a change in planned operations warrants a HASP update. All changes will be reviewed and approved by KeySpan personnel.

Note that GEI does not guarantee the health and safety of any person(s) entering the site. Due to the potential for the presence of hazards at the site and the proposed activity scheduled to occur within the boundaries of the site, it is not possible to discover, evaluate and provide protection from all potential hazards persons may encounter. Strict adherence to the specific items and procedures outlined in the HASP are intended to substantially reduce, but cannot fully eliminate, the potential for injury to persons present at the site. Also, the guidelines outlined in this HASP cannot be applied to sites and projects other than the Glen Cove former MGP RI project.

2. Medical Surveillance Program

GEI maintains a continuous, corporate, medical surveillance program that includes a plan designed specifically for field personnel engaged in work at sites where hazardous or toxic materials may be present. GEI employs the services of Health Resources of Woburn, Massachusetts to serve as national coordinator for the corporate medical surveillance program. Dr. Jerry Berke, an occupational health specialist with Health Resources, is the medical director responsible for the administration and coordination of medical evaluations conducted for GEI's employees at all branch office locations. Comprehensive examinations are given to all GEI field personnel participating in hazardous waste operations on an annual or biennial basis (as determined to be appropriate by Dr. Berke). The medical results of the examinations aid in determining the overall fitness of employees participating in field activities.

Dr. Berke's address and telephone numbers are:

Office: Health Resources
Three Hundred Four Cambridge Road
Woburn, Massachusetts 01801

Telephone: (617) 935-8581 or (800) 350-4511

Under Dr. Berke's supervision, all field personnel undergo a complete initial physical examination, including a detailed medical and occupational history, before they participate in hazardous waste site investigations. Extensive annual/biennial reexaminations are also performed. Upon completion of these tests, personnel are certified as to whether they are fit for field work in general, and fit to use all levels of respiratory protection, in particular. Detailed listings of testing/screening performed during a GEI medical evaluation are provided in Appendix A.

If a GEI employee or other project worker shows symptoms of exposure to a hazardous substance and wishes to be rechecked, he/she will be directed to Health Resources, an appropriate alternative physician, or if urgent, to an area hospital or medical facility. Dr. Berke will also act, as needed, as a medical consultant to GEI and provide information/advice on health risks and personal protection requirements associated with various chemical substances.

All GEI subcontractor personnel that will enter any active MGP waste handling or other active non-“clean” area must certify that they are participating in a medical surveillance program that complies with Occupational Safety and Health Administration (OSHA) regulations for hazardous waste operations (i.e., 29 CFR 1910.120 and 29 CFR 1926.65).

3. Emergency Support, Procedures, and Equipment

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly and require an immediate response; therefore, contingency planning and advanced training of staff are essential.

Specific elements of emergency support, procedures, and equipment which are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on site, other emergency equipment, record of on-site injuries, and the contingency plan.

3.1 Communications

Project personnel in the field will utilize verbal communication and/or a cellular telephone to communicate with others in the field.

A cellular telephone located in a designated on-site vehicle will enable field personnel to communicate directly with local emergency support units should an accident or injury occur during field operations.

3.2 Local Emergency Support Units

To facilitate dealing with any emergency that might occur during the RI, the names and telephone numbers of emergency support units and personnel (below) will be kept with the cellular phone in the designated on-site vehicle.

The following table is a list of contact telephone numbers to be used in case of an emergency.

Emergency Phone List
Glen Cove Former MGP Site

Emergency Medical Services (North Shore University Hospital)	
Emergency	911
All other communications	(516) 674-7300
Nearest Emergency Room (North Shore University Hospital)	(516) 674-7300
Fire Department (Glen Cove Fire Department)	
Emergency (general)	911
Emergency (Glen Cove Fire Department)	(516) 671-3437
All other communications	(516) 676-0366
Police Department	
Emergency (ambulance)	911
All other communications	(516) 676-1000
Toxicological Consultant (Dr. Thomas Berke, M.D.)	(617) 935-8581
Utility Emergencies	
Electric (Con Edison)	(516) 545-5310 or (516) 755-6900
Water/Sewer	(516) 676-5096
Gas (KeySpan)	(516) 545-5310 1-800-490-0045
Hazardous Material Spills or Releases	
Long Island Power Authority (Burt Cunningham-Vice President of Communications)	(516) 719-9838
KeySpan Site Contact	
Thomas Campbell	(516) 545-2555
Underground Utilities (New York Long Island One Call Center)	(800) 272-4480
National Information Centers	
Chemtrec	(800) 424-9300
National Response Center	(800) 424-8802
Poison Control Center	(800) 222-1222 or (516) 663-2650

3.3 Preparation for Medical Emergencies

GEI has determined that the North Shore University Hospital has the facilities and personnel needed to treat injuries resulting from project hazards, including exposure to any of the contaminants/materials expected to be handled during the project or from possible injuries from project hazards. The chemical products that potentially caused, or are potentially related to, known/anticipated on-site contaminants are described in the Material Safety Data Sheets (MSDSs) and Occupational Health Guidelines (as available) provided in Appendix B. Instructions for finding the hospital will be kept available at the site by the Site Safety Officer (SSO). The best route from the site to the North Shore University Hospital is documented and illustrated in Figure 3.

Before the project commences, each person who will be working on the project or observing the operations will complete a medical data form that includes the following information.

- Name, address, home telephone
- Age, height, weight
- Name of person to be notified in case of emergency
- All prescription and nonprescription medications currently being used
- Allergies
- Particular sensitivities
- Use of contact lenses or eyeglasses
- Short medical history, including list of previous illnesses and any prior exposure to chemicals
- Name and telephone number of personal physician

These data forms will be filled out during the initial project-safety training meeting before any work begins on the project. Maintenance and filing of the medical forms will be the responsibility of the SSO (see Appendix C for sample data form).

In the event of an incident where a project worker suffers from an injury or acute symptom of exposure to site materials and has to be taken to a hospital, a copy of the employee’s medical data sheet will be presented to the attending physician.

3.3.1 First Aid Equipment

Portable first-aid kits and emergency eyewash stations will be readily available to project personnel when performing field operations. Personnel will be informed of the location of the first-aid and eyewash stations during the project safety briefing.

The first-aid kits that will be kept at the site will consist of a weatherproof container with individually sealed packages for each type of item. The kit will include at least the following items.

- Gauze roller bandages, 1-inch and 2-inch
- Gauze compress bandages, 4-inch
- Gauze pads, 2-inch
- Adhesive tape, 1-inch
- Adhesive bandages, 1-inch
- Butterfly bandages
- Ampules of ammonia inhalants
- Antiseptic applicators or swabs
- Burn dressing and sterilized towels
- Scissors
- Eye dressing
- Emergency eye-wash
- Alcohol
- Hydrogen peroxide
- Artificial respiration mouth shield
- Clinical grade thermometer

3.3.2 Infectious Materials and Bloodborne Pathogens Exposure Control Plan

The Infectious Materials and Bloodborne Pathogens Exposure Control Plan provides methods so that employees working in direct contact with infectious agents are properly protected as required by OSHA 29 CFR 1910.1030 - Bloodborne Pathogens.

Standard Procedures

All procedures and manipulations of potentially infectious materials shall be performed in a manner that minimizes the potential for creating splashes, droplets, or aerosols.

Mechanical pipetting devices shall be used for manipulating all sanitary sewer effluent. Mouth pipetting is prohibited.

The use of glassware or equipment with sharp or pointed edges shall be kept at a minimum to reduce the potential for injection of infectious materials.

All minor cuts, scratches, or other breaks in the skin barrier shall be covered prior to the handling of infectious materials. Employees experiencing exudative lesions or weeping dermatitis shall refrain from direct contact with infectious materials.

Eating, drinking, smoking, or application of cosmetics is not permitted in areas where potentially infectious materials are handled or sampled.

Employees shall wash and disinfect their hands, face, or any other potentially contaminated skin surfaces upon completing the handling of infectious or potentially infectious agents.

Personal Protective Equipment

Personal protective equipment shall be worn to reduce the potential of exposures to splashes or aerosols. At a minimum, this equipment shall include safety glasses and gloves, but may also require the use of face, respiratory, foot, and full-body protection.

Gloves used in the handling or sampling of infectious materials shall be disposed and not reused.

Medical Monitoring

Employees who may be potentially exposed to infectious materials or bloodborne pathogens shall participate in the GEI medical monitoring program.

For infectious agents in which a medically accepted vaccination has been developed (e.g., HBV) potentially exposed employees shall be given the option to receive the inoculate at no cost.

Employees who have been exposed shall be given the option to receive a confidential medical evaluation at no cost.

All required records for exposed employees shall be kept confidential.

Storage

All samples of infectious agents shall be placed in a container with a secure lid to prevent leaking during transportation.

Samples of potentially infectious materials shall not be stored in cabinets or refrigerators designated for food consumption. Samples shall be placed in appropriate, labeled containers and disposed of properly.

Lab benches, floors, or other work surfaces that come in contact with potentially infectious agents or bloodborne pathogens shall be disinfected with a bleach solution or germicide.

Upon completion of work activities, all disposable personal protective equipment that comes in direct contact with potentially infectious agents shall be sanitized with a bleach solution or a sanitizer and discarded with appropriate procedures.

3.4 Other Emergency Equipment

ABC-rated portable fire extinguishers and emergency air horns (to signal evacuation) will be located at readily accessible locations at the site. Personnel will be informed of the locations of the fire extinguishers and air horns during the project safety briefing. In addition, fire extinguishers and air horns will be located on excavation equipment during excavating activities. Fire extinguishers will be properly maintained and tagged (indicating inspection/maintenance dates).

An emergency at the site, such as a fire or chemical release, might require that some appropriately trained site workers direct traffic on or near the site. GEI would be equipped to do this before emergency support arrives. Reflective vests, traffic cones (or equivalent), and fluorescent flags to be used for traffic control will be kept readily available on site in the designated on-site project vehicle.

3.5 Record of On-Site Injuries

3.5.1 Occupational Injuries and Illnesses

All injuries will be reported to the SSO and KeySpan as soon as practicable. An accident report (Appendix D) will be completed by the SSO for all incidents.

All occupational injuries and illnesses that are required to be recorded under the Occupational Safety and Health Act will be recorded on OSHA Form 300 (Appendix E) by GEI's or the subcontractor's safety personnel within 48 hours of occurrence as is required by statute.

3.5.2 Employer's First Report of Injury

The Employer's First Report of Injury form (Appendix F) will be completed by the SSO for all accidents involving worker injury at the site. Follow-up procedures will include investigation of each accident or near-miss by the SSO to ensure that no similar accidents that may lead to injuries occur.

3.6 Contingency Plan

Each of the contractors and subcontractors providing major services will produce contingency plans addressing potential emergencies that may arise as a result of their operation. The SSO will be made aware of emergencies and coordinate any response activities carried out at the site. The SSO will serve as the overall PEC for GEI and GEI subcontractor personnel and will have the ultimate authority in specifying and facilitating any contingency action.

If unable to perform these duties, the SSO will specify another senior individual to serve in this capacity. The PEC will become familiar with contingency plans developed by each contractor and subcontractor.

3.6.1 Identifying the Hazards and Assessing the Risk

The PEC's objectives during any emergency shall be to protect human health and safety, and then the environment. Possible hazards to human health or the environment that may result from any emergency situation will be identified by the PEC. The PEC must take into consideration both direct and indirect effects of the incident.

The PEC will then assess the possible risks to human health or the environment that may result from the emergency (e.g., release, fire, explosion, or severe weather conditions). He will make this assessment by:

- Identifying the materials involved in the incident
- Consulting the appropriate Occupational Health Guideline or MSDS to determine the potential effects of exposure/release, and appropriate safety precautions

- Identifying the exposure and/or release pathways and the quantities of materials involved

Based on this information, the PEC will determine the best course of action for dealing with the emergency, and possible follow-up requirements that may result from implementing those actions (e.g., equipment repair, material disposal, etc.).

If the incident cannot be controlled by operating personnel without incurring undue risk, the PEC will implement the Site Evacuation Procedures (subsection 5.30.1). If the off-site neighboring population is at risk, the off-site evacuation procedures (subsection 5.30.2) will be implemented. The PEC will notify the appropriate governmental agencies and departments that a situation resulting in evacuation has occurred. Should emergency assistance be required for treating injuries or carrying out the evacuation, the PEC will request assistance of the appropriate parties.

3.6.2 Conditions for Implementing a Contingency Plan

Some of the conditions under which the contingency plan would be implemented are:

- Fire or explosion
- Occurrence of a spill or material release
- Severe weather conditions
- Physical or chemical injury to a worker

3.6.2.1 Fire and/or Explosion Conditions

Contingency procedures will immediately be implemented upon notification that any of the following scenarios involving fire and/or explosion is imminent or has occurred.

- A fire that causes, or could cause, the release of toxic fumes

- A fire that could possibly ignite nearby flammables or could cause heat-induced explosions

- A fire that could possibly spread to off-site areas

- A danger exists that an explosion could occur causing a safety or health hazard

- An explosion has occurred

3.6.2.2 Spill or Material Release Conditions

Any of the following scenarios involving a spill or material release, whether imminent or having already occurred, will cause implementation of contingency procedures.

- A spill or material release that could result in the release of flammable liquids or vapors, thus causing a fire or gas explosion hazard

- A spill or material release that could cause the release of toxic vapors or fumes into the atmosphere in concentrations higher than the applicable OSHA permissible exposure limits (PELs)

- A spill or material release that can be contained on site where a potential exists for groundwater or surface water contamination

- A spill or material release that cannot be contained on site, resulting in a potential for off-site soil contamination and/or groundwater or surface water pollution

The PEC (or the GEI subcontractor’s Emergency Coordinator if the subcontractor is responsible for the spill or material release) will immediately identify the character, source, amount, and extent of any release. Spills or material releases shall be reported immediately to the PEC. Initial identification will be based on visual analysis of the material and location of the release. If the release material cannot be identified, samples will be taken for analysis.

3.6.2.3 Severe Weather Conditions

The following severe weather conditions, whether imminent or having occurred, may cause implementation of contingency procedures.

- A tornado has been sighted in the area
- A tornado warning is in effect for the area
- A lightning storm is underway in the area (storm center less than 5 miles away)
- Other severe weather or weather-induced conditions (e.g., hurricane, flood)

3.6.2.4 Physical or Chemical Injury Conditions

The following worker injuries may cause implementation of the Contingency Plan.

- Major physical injuries
- Chemical injuries

- Severe symptoms of chemical overexposure

3.6.3 Contingency Procedures

If any of the aforementioned conditions for implementing the Contingency Plan are met, the appropriate following contingency procedure(s) shall be performed.

3.6.3.1 Contingency Procedures for Fire/Explosion

When fire or explosion appear imminent or have occurred, all normal activity in affected areas will cease. The PEC will make an assessment of the potential risk and severity of the situation to decide whether the emergency event will or will not be readily controllable with existing portable fire extinguishers or site equipment and materials at hand. Fire fighting will not be done at any risk to operating personnel. Local fire departments will be contacted in all situations in which fires and/or explosions have occurred. The following steps will be taken for a localized fire.

- Contact local fire departments
- Move all personnel to an upwind location at an appropriately safe distance away
- Determine if the fire is within the capabilities of on-site personnel to attempt initial fire fighting
- If the fire is within the capabilities of on-site personnel, utilize most appropriate means of extinguishing fire (e.g., fire extinguishers, water, covering with soil, etc.)
- Once fire is extinguished, containerize and properly dispose of any spilled material, runoff, or soil

If the situation appears uncontrollable and poses a direct threat to human life, fire departments will be contacted and the Evacuation Plan will be implemented. If the chances of an impending explosion are high, the entire area within a 1,000-foot radius of the fire source will be evacuated. The PEC will alert personnel when all danger has passed, as determined by the chief firefighter from the responding fire department. All equipment used in the emergency will be cleaned and refurbished as soon as possible after the emergency has passed so that it will be ready for use in the event of any future emergency.

3.6.3.2 Contingency Procedures for Spills or Material Release

If a hazardous waste spill or material release or process upset resulting in probable vapor release is identified, the PEC will immediately assess the magnitude and potential seriousness of the spill or release based on the following.

- MSDS and/or Occupational Health Guidelines (as available) for the material spilled or released
- Source of the release or spillage of hazardous material
- An estimate of the quantity released and the rate at which it is being released
- The direction in which the spill or air release is moving
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result
- Potential for fire and/or explosion resulting from the situation
- Estimates of area under influence of release

If the spill or release is determined to be within the capabilities of on-site emergency response personnel, the PEC will ensure implementation of the necessary remedial action. If the accident is beyond the capabilities of the operating crew, all personnel not involved with emergency response activity will be evacuated from the immediate area and the PEC will notify the appropriate authorities and, if necessary, engage the services of a spill response contractor.

3.6.3.3 Contingency Procedures for Severe Weather

When a tornado is sighted in the area, when a tornado warning has been issued, or when a lightning storm occurs, the information will be immediately relayed to the PEC. In the case of a tornado sighting, the PEC will then institute emergency shutdown procedures, and all personnel will be directed to proceed indoors after completing appropriate shutdown procedures. In the case of a tornado warning or lightning storm, the PEC will have operations stopped and direct all personnel to stand by for emergency procedures. Other types of severe weather or weather-induced conditions (i.e., hurricane or flooding) for which long-range prediction is available may also require positive action as identified herein.

When the severe weather has passed, the PEC will direct all contractors to inspect on-site equipment to ensure its readiness for operation prior to restarting operations. If an inspection indicates a fire, explosion, or release has occurred as the result of a severe weather condition, the procedures for those events will be followed

3.6.3.4 Contingency Procedures for Physical Injury to Workers

Regardless of the nature and degree of the injury, the PEC will be appraised of all injuries requiring first aid of any kind. Upon notification that a worker has been injured, the PEC will immediately determine the severity of the accident, and whether the victim can be safely moved from the incident site. Appropriate medical assistance will be summoned immediately.

Minor injuries sustained by workers will be treated on site using materials from the first-aid kits. Whenever possible, such treatment will be administered by trained personnel in a “clean” zone. Examples of minor injuries include small scrapes and blisters. Minor injuries would not be expected to trigger implementation of the contingency plan.

Major injuries sustained by workers will require professional medical attention at a hospital. The PEC will immediately summon an ambulance and contact the hospital to which the injured worker will be transported. The hospital and ambulance should be advised of the following.

- The nature of the injury
- The present condition of the injured worker (e.g., conscious, breathing)
- When and where the injury was sustained
- Whether the injured worker will be decontaminated prior to transport

A report of the injury or incident will be incorporated into the field logbook.

3.6.3.5 Contingency Procedures for Chemical Injury to Workers

Injuries involving hazardous chemicals or symptoms of severe chemical overexposure will automatically trigger implementation of the contingency plan. Upon notification that a chemical injury has been sustained or severe symptoms of chemical exposure are being experienced, the PEC will notify the hospital and ambulance of the occurrence. The PEC will provide, to the extent possible, the following information.

- The nature of the injury (e.g., eyes contaminated)
- The chemical(s) involved
- The present condition of the injured worker (e.g., conscious, breathing)

- When and where the injury was sustained
- Whether the injured worker will be decontaminated prior to transport

Steps will immediately be taken to remove the victim from the incident site using whatever personal protective equipment (PPE) and safety equipment is necessary. Rescuers will check for vital signs and, if possible, remove contaminated outer clothing. If the victim's eyes have been contaminated, personnel trained in administering first aid will flush the victim's eyes with eyewash solution until the emergency response team arrives.

Details on the nature of the contaminant and methods for treating exposure or injury can be obtained from the MSDS or Occupational Health Guidelines as provided in Appendix B. MSDSs and Occupational Health Guidelines (as available) for the contaminants at the site, as well as for hazardous materials employed in the remediation or decontamination process, will be maintained at the site. If practicable, a copy of the MSDS(s) or Occupational Health Guidelines for the contaminant(s) involved in the injury will be provided to the hospital.

4. Training Programs

4.1 Health and Safety Training

All GEI personnel and subcontractors assigned to perform on-site work for this project have attended an initial 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course, health and safety training course, and a current 8-hour refresher course (as required annually after initial training) in compliance with OSHA requirements. Also, a number of GEI personnel have completed the 8-hour HAZWOPER Supervisory Training Course. The following list of GEI project personnel includes the type and dates of the HAZWOPER safety courses that they have attended.

Name	HAZWOPER Training	Annual Refresher	Supervisory Training
Dave Terry	12/90	3/03	12/91
Lynn Willey	10/96	3/03	9/01
Christopher Dailey	7/98	4/03	---
TBD	--	--	---

The training courses are comprised of classroom instruction, field demonstrations, hands-on use of respirators and protective clothing, and written and field examinations. The HAZWOPER training typically covers the following topics.

- Identification of hazardous substances
- Properties of hazardous substances
- Routes of exposure
- Toxicity of different substances and their synergistic effects
- Practical considerations in health and safety management
- Physical properties of chemicals
- References for threshold limit values (TLV), lower explosion limits (LEL), toxicity data, cross references
- Technical assistance organizations
- Air monitoring and survey instruments
- Site entry and egress procedures
- Heat stress monitoring

- Levels of personnel protection
- Controlling access to work zones and other contaminated areas
- Personnel decontamination
- Equipment decontamination
- Site/area safety planning

Persons attending the courses typically are fit tested with half and/or full face respirators and receive training in the use of self-contained breathing apparatus (SCBA). The importance of, and the procedures for, decontamination are discussed in the course as well.

Health and safety training is an ongoing activity at GEI. Annual health and safety refresher courses are provided to keep field personnel up to date with proper health and safety practices. Site-specific training programs are presented as needed. Re-familiarization and fit testing of personal respirators is conducted annually.

All subcontractors, visitors, or other personnel that will enter the project exclusion zones or any other MGP waste-handling area at the site must provide proof of having current HAZWOPER training certifications. Project management and supervisory personnel must also provide proof of having HAZWOPER supervisory training. Personnel without HAZWOPER supervisory training will not be allowed to work in an exclusion zone or any other MGP waste handling area without having a supervisory trained person on site.

All site visitors must be escorted. Access for visitors not having current HAZWOPER certifications will be limited to clean areas.

4.2 On-Site Training Program

The SSO will conduct an on-site training meeting for all personnel and observers before they are permitted to participate in any operations involving MGP waste excavating, handling, or processing, or other work in exclusion zones or MGP waste-handling areas. Training meetings will be provided routinely for any new project personnel. This program will cover specific health and safety equipment and protocols and potential problems inherent to each project operation. No person will be allowed to work in restricted (e.g., waste excavation/handling/ processing) areas prior to attending a project-training meeting. During the meeting, the HASP will be reviewed and each individual will read the complete Site Safety Plan (Section 5). Copies of the HASP will be kept available on site by the SSO for the project duration. The major components of the on-site training are as follows.

- Project organizational structure, lines of authority, responsibility and communication

- General review of the scope of activities and associated hazards for each project operation the personnel are to be involved in or potentially exposed to hazards

- Review of chemical hazards that may be expected to occur, their forms (e.g., vapor, gas, liquid), and the warning signs of their presence

- Review of potential hazards posed by excavating in the presence of underground utilities and other unidentified hazards

- Equipment/personnel decontamination procedures

- Locations of communications equipment

- Emergency equipment locations

- Emergency and evacuation procedures

- Operational procedures:

  - Control of site activities
  - Control of site access and perimeter
  - Zones of hazard
  - Levels of protection
  - Detection equipment
  - Decontamination procedures

- Emergency procedures:

  - First aid
  - Emergency communications
  - Local response groups and their telephone numbers
  - Evacuation procedures

- Respirator fit testing requirements for all personnel prior to commencing use at the site

- Site-specific safety rules

- Complete reading of the Site Safety Plan (Section 5 of this HASP) followed by signing of the document to confirm the effort

Additional safety meetings will be held if necessitated by changing site conditions, new operating procedures, or the entry of new personnel unfamiliar with important daily safety topics. A record will be kept of safety meeting dates and attendees (Appendix G).

4.3 Earth-Moving Equipment Safety

A number of personnel will be assigned to act as earth-moving equipment operators at the site. They will be responsible for activities such as excavating and transporting contaminated materials and backfilling excavations with clean materials. All earth-moving activities will be conducted such that contact between contaminated materials and equipment is kept to the necessary minimum, and all work is performed in accordance with the RI Work Plan.

Earth-moving equipment operators will be trained and experienced in the safe operation of construction equipment and will hold valid operating licenses (where required) for the equipment they are assigned to operate. They will also perform necessary emergency operations as directed by the SSO.

5. Site Safety Plan

This Site Safety Plan section of the Health and Safety Plan (HASP) is sufficiently detailed to be used as a stand-alone document. This plan establishes policies and procedures to protect workers and the public from the potential hazards posed by the RI activities at the Glen Cove former manufactured gas plant (MGP) site. Reading of the Site Safety Plan is required of all on-site GEI Consultants, Inc. (GEI) personnel and GEI subcontractors. The plan identifies measures to minimize accidents and injuries, which may result from project activities or during adverse weather conditions.

5.1 General Information

5.1.1 Site Description

5.1.1.1 Location and Access

- The Glen Cove former MGP site is located near the north shore of Long Island, New York, east of Hempstead Harbor, at the intersection of two transportation corridors, Long Island Railroad (LIRR) and Route 107. Figure 1 depicts the site and surrounding community. The site covers a 1.91-acre area and its configuration is roughly L-shaped (Figure 1). A mixed commercial/residential neighborhood is located east and south of the site. The site is the location of an electrical substation currently operated by the Long Island Power Authority (LIPA). Topographically, the site resides in a depression bounded on the north by an embankment leading up to LIRR tracks. On the east and south sides of the site, residential properties sit above the steep embankments bordering the site. The west side of the site is wooded and slopes toward the culverted Glen Cove Creek. Route 107 is located west of Glen Cove Creek. Site access is via an access road from Grove Street (Stanco Street). The entire substation portion of the site is fenced, as is access to the wooded western portion of the site, and access from Grove Street. Figure 1 depicts the site location and Figure 2 summarizes current site conditions and historic MGP related structures.

5.1.1.2 Buried Utilities

All underground utilities will be marked by the New York One Call Center prior to initiation of intrusive work (electric, gas, telephone, sewer, water and cable). Because the site is an active transformer station, KeySpan will obtain current available utility plans for the substation.

Additionally, each subsurface boring location will be hand-cleared or cleared with a utility clearance machine to the KeySpan or LIPA requirements. Additional utility clearances will be performed on private properties in accordance with the RI Work Plan and applicable Subcontractor Agreements.

5.1.1.3 Topography

The site is located within a topographic depression with steep embankments on the northern southern and eastern portions of the site. Land surface topography of the substation area of the site is relatively flat and is approximately 58 feet above mean sea level (MSL) and slopes toward Glen Cove Creek which is located to the west of the site which is approximately 50 feet MSL. Steep embankments surround the site and are approximately 80 feet MSL

5.1.1.4 Surrounding Population

The site is primarily surrounded by residential development with commercial development and transportation corridors (LIRR and Route 107 [Glen Cove Highway]) surrounding the site.

5.1.1.5 Perimeter Control

The site is surrounded by a secured by a chain-link fence. Safety cones with highly visible caution tape will be used to secure other portions of the work area when the gate is unsecured. All excavations shall be properly barricaded. All waste storage areas will be sufficiently lined or bermed at the site perimeter, as appropriate, to prevent any off-site exposures.

5.1.1.6 Emergency Response Capabilities

The Glen Cove Fire Department will respond to incidents involving actual or imminent fire, explosion, or hazardous material spills emergencies. The Glen Cove Police Department dispatches emergency services will respond to medical emergencies on site, and provide transportation to the hospital. North Shore University Hospital is fully equipped to deal with injuries and chemical exposures (see subsection 3.3).

5.2 Project Objectives

This plan is written specifically to cover operations to be performed during the Glen Cove former MGP RI, which involves the following:

- Air monitoring
- Surface and subsurface soil sampling
- Soil borings, monitoring well installation, and well development

- Groundwater sampling and hydraulic conductivity testing
- Site survey
- Soil/material handling and transport activities
- Site survey
- Other work as applicable

5.3 Authorized Site Personnel

Prior to mobilizing to the site, all project subcontractors will identify those individuals in their employ who will be working on the site, their safety training dates, and the status of their medical surveillance program. All personnel arriving or departing the site are required to log in and out with a designated record keeper. All personnel and activities on site must be authorized by the GEI Project Manager or by his designee.

5.4 Control of Site Access

A chain-link fence and/or safety cones with caution tape or other equivalent means will secure the investigation area of the Glen Cove former MGP site. The investigation area (i.e., proposed sample locations) is depicted in the Work Plan.

- The GEI Field Team Leader will be responsible for ensuring control of access to all work areas and restricted zones on site. Boundaries have been delineated for the different areas.

- A worker and visitor log (log in, log out) will be maintained on site during field operations.

If site conditions develop that require changes in the established boundaries, the SSO and the Project Manager or their designees will be notified immediately. The field boundaries will be re-marked, and a meeting will be held for site personnel to inform them (on an as-needed basis) of the changes, the reasons that caused them to be made, and any new health and safety practices that might be necessary as a result of the altered site conditions. If necessary, to ensure health and safety, the site HASP maps/figures will be revised (as applicable) to show the new configuration of controlled areas.

5.5 Chemical Safety and Handling

All hazardous chemicals must be stored at the site in containers that are in good condition with proper labeling. Personnel handling the chemicals must use proper PPE and have knowledge of the chemical's physical properties and hazards. An inventory of all chemicals used and stored at the site will be maintained and available upon request. All MSDSs for chemicals used at the site will be submitted and approved by KeySpan prior to use.

5.6 Evaluation of Potential Chemical Hazards

MGP waste contaminants include ferrocyanides from purifier wastes, semi volatile organic compounds (SVOCs), volatile organic compounds (VOCs) (e.g., benzene, toluene, ethylbenzene and xylenes), polycyclic aromatic hydrocarbons (PAHs), and heavy metals (e.g., chromium, arsenic, lead, mercury, and zinc) from tars. Transformers currently on-site could potentially contain polychlorinated biphenyls (PCBs).

The potential primary hazards of each contaminant are identified as follows. Note that the matrices specified for each contaminant are not necessarily exclusive but are based on the best existing information of the site. This Site Safety Plan is intended to be sufficiently stringent to ensure worker protection from all of the potential contaminants listed, regardless of matrix.

CONTAMINANT:	**Volatile Organic Compounds** (VOCs, potentially including benzene, toluene, ethylbenzene, and xylenes, [BTEX])			
Possible Sources:	Fuels, Oils and Other Petroleum Products			
Form:	Gas ☐	Liquid ☒	Solid (adsorbed) ☒	Other _Vapor
Characteristic:	Corrosive ☐	Ignitable ☒	Radioactive ☐	Volatile ☒
	Toxic ☒	Reactive ☐	Other _________	Unknown ☐
Matrix:	Soils ☒	Debris ☒	Groundwater ☒	Other _Airborne Vapor

CONTAMINANT:	**Polycyclic Aromatic Hydrocarbons (PAHs), including naphthalene**			
Possible Sources:	MGP Tars, Petroleum Products, Products of Incomplete Combustion			
Form:	Gas ☐	Liquid ☒	Solid (adsorbed) ☒	Other ______________
Characteristic:	Corrosive ☐	Ignitable ☐	Radioactive ☐	Volatile ☐
	Toxic ☒	Reactive ☐	Other _________	Unknown ☐
Matrix:	Soils ☒	Debris ☒	Groundwater ☐	Other _Fugitive Dust___

CONTAMINANT:	**Cyanide Compounds (primarily ferrocyanides of low toxicity)**			
Possible Sources:	Purifier Waste Disposal			
Form:	Gas ☐	Liquid ☐	Solid (adsorbed) ☒	Other _HCN Gas*_____
Characteristic:	Corrosive ☐	Ignitable ☐	Radioactive ☐	Volatile ☐
	Toxic ☒	Reactive ☐	Other __________	Unknown ☐
Matrix:	Soils ☒	Debris ☒	Groundwater ☐	Other _Airborne Vapor__

CONTAMINANT:	**TAL Metals**			
Possible Sources:	Site Debris			
Form:	Gas ☐	Liquid ☐	Solid (adsorbed) ☒	Other ______________
Characteristic:	Corrosive ☐	Ignitable ☐	Radioactive ☐	Volatile ☐
	Toxic ☒	Reactive ☐	Other __________	Unknown ☐
Matrix:	Soils ☒	Debris ☒	Groundwater ☐	Other _______________

CONTAMINANT:	**Polychlorinated biphenyls (PCBs)**			
Possible Sources:	Transformer Oils			
Form:	Gas ☐	Liquid ☐	Solid (adsorbed) ☒	Other ______________
Characteristic:	Corrosive ☐	Ignitable ☐	Radioactive ☐	Volatile ☐
	Toxic ☒	Reactive ☐	Other __________	Unknown ☐
Matrix:	Soils ☒	Debris ☐	Groundwater ☐	Other _______________

* The potential exists for Hydrogen Cyanide gas to be present in subsurface void spaces. Due to this potential, air monitoring for Hydrogen Cyanide gas will be performed during all invasive site work.

Material Safety Data Sheets (MSDS) (as available) and/or Occupational Health Guidelines for contaminants potentially found at the site (and/or for products that are potentially the source of contamination), and for decontamination chemicals that may be used on site, are included in Appendix B.

The potential exposure routes associated with the contaminants that will potentially be encountered by workers during the investigations are listed below.

Substances Involved	**Primary Exposure Routes**
VOCs	Vapor inhalation, skin or eye contact
PAHs	Inhalation of fugitive dust, ingestion
Ferrocyanides	Inhalation of fugitive dust, ingestion
PCBs	Inhalation of fugitive dust, ingestion, skin contact
TAL Metals	Inhalation of fugitive dust, ingestion

Specific chemical hazards information from the MSDS and Occupational Health Guidelines are summarized in the chemical data table on the next page.

CHEMICAL DATA

COMPOUND	CAS#	ACGIH TLV	OSHA PEL	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Benzene	71-43-2	0.5 ppm (skin)	1 ppm TWA 5 ppm STEL	Inhalation Skin Absorption Ingestion Skin Contact	**Acute**: Irrit eyes, skin, nose, resp system, and nausea. **Chronic**: dermatitis	Eyes, skin, CNS, bone marrow, blood, potential carcinogen	FP: 12^{o} F IP: 9.24 eV LEL: 1.2% UEL: 7.8% VP: 75 mm
Ethylbenzene	100-41-4	100 ppm	100 ppm	Inhalation Ingestion Skin Contact	**Acute**: Eye, skin, mucous membrane irritation, headache, narcosis; coma **Chronic**: dermatitis	Eyes, skin, respiratory system, CNS	FP: 55^{o} F IP: 8.76 eV LEL: 0.8% UEL: 6.7% VP: 7 mm
Toluene	108-88-3	50 ppm	200 ppm	Inhalation Skin Absorption Ingestion Skin Contact	**Acute**: Eye, nose irritation; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, lacrimation; nervousness, muscle fatigue, insomnia, tingling in limbs; **Chronic**: dermatitis	Eyes, skin, resp system, CNS, liver, kidneys	FP: 40^{o} F IP: 8.82 eV LEL: 1.1% UEL: 7.1% VP: 21 mm

CHEMICAL DATA
Continued

COMPOUND	CAS#	ACGIH TLV	OSHA PEL	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Xylene	1330-20-7	100 ppm	100 ppm	Inhalation Skin Absorption Ingestion Skin Contact	**Acute**: Eye, skin, nose, throat irritation; dizziness, nausea, vomiting, “drunkenness”, excitement, drowsiness; **Chronic**: corneal damage; appetite loss, abdominal pain; dermatitis	Eyes, skin, resp system	FP: 90^{o} F IP: 8.56 eV LEL: 0.9% UEL: 6.7% VP: 9 mm
Lead	7439-92-1	0.050 mg/m^3	0.05 mg/m^3	Inhalation Ingestion Skin Contact	**Acute**: Fatigue, insom, pallor, irrit eyes, difficulty concentr. **Chronic**: Headaches, weight loss; abdominal distress; anemia; gingival lead line; tremor; para wrist, ankles	eyes, gi tract, cns, kidneys, blood, gingival tissue,	A heavy, ductile, soft, gray solid. FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
PAH’s as Coal tar pitch volatiles (CTPV)	65996-93-2	0.2 mg/m3	0.2 mg/m3	Inhalation Skin contact Ingestion	**Acute**: Irritant to eyes, swelling **Chronic**: acne, contact dermatitis, chronic bronchitis	Respiratory system, CNS, liver, kidneys, skin, bladder	Black or dark brown amorphous residue.

CHEMICAL DATA
Continued

COMPOUND	CAS#	ACGIH TLV	OSHA PEL	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Hydrogen Cyanide	74-90-8	5 mg/m3	11 mg/m3	Inhalation Skin Absorption Ingestion Skin/eye Contact	**Acute**: Asphyxia; lassitude; headache, confusion; nausea, vomiting; increased rate and depth of respiration or respiration slow and gasping; **Chronic**: thyroid, blood changes	CNS, CVS, thyroid, blood	Colorless or pale blue liquid or gas with a bitter, almond-like odor
Polychlorinated biphenyls (PCBs)	1336-36-3	1 mg/m3 (skin)	1 mg/m3 (skin)	Inhalation Skin Absorption Ingestion Skin/eye contact	**Acute:** Skin, eye, nose, throat irritation, nausea, vomiting, fatigue, and cognitive effects; **Chronic**: Potential liver toxins, neurological symptoms, cancer	CNS, eyes, GI tract, liver, kidneys and skin	Mobile oily liquids to white crystalline solids and hard non-crystalline resins. FP: NA BP = 644-707^{o} IP: NA UEL : NA LEL: NA VP: 1 mm

Abbreviations

C = ceiling limit, not to be exceeded
CNS = Central Nervous System
CVS = Cardiovascular System
eV = electron volt
LEL = Lower explosive limit
Mm = millimeter
ppm = parts per million
Skin = significant route of exposure

Abbreviations Continued

FP = Flash point
IP = Ionization Potential
GI = Gastro-intestinal
STEL = Short-term exposure limit (15 minutes)
TWA = Time-weighted average (8 hours)
UEL = Upper explosive limit
VP = vapor pressure approximately 68° F in mm Hg (mercury)

Acute – Adverse effect on the body that can develop after a single exposure.

Chronic – Adverse effect on the body that can develop after multiple and/or long-term exposure.

5.7 Biological Hazards

During the course of the project, there is a potential for workers to come into contact with biological hazards such as animals, insects, and plants. Workers will be instructed in hazard recognition, health hazards, and control measures during site-specific training.

5.7.1 Animals

During the conduct of site operations, wild animals such as stray dogs or cats, birds, and mice may be encountered. Workers shall use discretion and avoid all contact with wild animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed animal control technician.

5.7.2 Insects

Insects, including bees, wasps, hornets, and spiders, may be present at this site making the chance of a bite possible. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life threatening condition; any individuals who have been bitten or stung by an insect should notify the SSO immediately. The following is a list of preventive measures:

- Apply insect repellent prior to field work and or as often as needed throughout the work shift.
- Wear proper protective clothing (work boots, socks and light colored pants).
- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.
- Field personnel who may have insect allergies should provide this information to the SSO prior to commencing work, and shall have bee sting allergy medication on site.
- The SSO will instruct the field crew in the recognition and procedures for encountering poisonous insects at the site.

5.7.3 West Nile Virus

West Nile Virus (WNV) is a mosquito-borne infection that can cause encephalitis. Since the initial outbreak in 1999, the virus has spread rapidly throughout New York State. There are about 65 different species of mosquitoes in New York State, but only a small percentage have been associated with WNV. Most mosquitoes are not infected and the chance of infection from a mosquito bite of an on-site worker is very small. All residents of areas where virus activity has been identified are at risk of getting WNV, but those at highest risk for becoming seriously ill from WNV are people over 50.

The following precautions will be used to help reduce the risk of mosquito bites:

- Reduce mosquito-breeding areas by making sure that wheelbarrows, buckets, and other containers are turned upside down when not being used so that they do not collect standing water.

- Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many mosquitoes are most active (between dusk and dawn).

- Use mosquito repellent according to label directions when outdoors for long periods of time and when mosquitoes are most active.

5.7.4 Plants

The potential for contact with poisonous plants exists when performing field work in undeveloped areas. Poison ivy, sumac, and oak may be present on site. Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring. Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves, which are velvety dark green on top and pale underneath. The branches of immature trees have a velvety "down." Poison sumac has white, "hairy" berry clusters. Poison oak can be present as a sparingly branched shrub. Poison oak is similar to poison ivy in that it has the same leaflet configuration; however, the leaves have slightly deeper notches. Contact with poison ivy, sumac, or oak may lead to a skin rash, characterized by reddened, itchy, blistering skin which needs first aid treatment. If you believe you have contacted one of these plants, immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.

5.8 Levels of Protection For Site Workers

This subsection stipulates personal protective equipment (PPE) requirements for different tasks during the RI activities. The designated levels of protection have been based on an evaluation of potential hazards and risks associated with work during the project.

5.8.1 Levels of Protection Required

PPE required for each level of protection is as follows.

Safety Equipment	Level A	Level B	Level C	Level D
Tyvek^{TM} suit or work overalls				•
Hard hats with splash shields or safety glasses			•	•
Steel-toe boots			•	•
Chemical-resistant gloves as appropriate for work being performed and materials handled			•	•
Half- or full-face respirators with organic/HEPA cartridges as approved by the SSO			•	
Tyvek^{TM} splash-resistant suit			•	
Chemical-resistant clothing		•		
Pressure-demand, full-face SCBA or pressure-demand supplied air respirator with escape SCBA	•	•		
Inner and outer chemical-resistant gloves	•	•		
Chemical-resistant safety boots or shoes	•	•		
Two-way radio	•	•		
Hard hat	•	•		
Fully encapsulating chemical-resistant suit	•			

PPE requirements for field activities are as follows.

Activity	Level of Protection	Backup Protection
Test Boring and Soil Sampling	D	C
Monitoring Well Installation/Development/Sampling/Survey	D	C
Air Monitoring	D	C
Waste Management/Handling	D	C

The SSO will closely monitor the work schedules listed in the project logbook to be sure that all workers entering the site have had their safety briefing and that the amount of PPE kept on site is sufficient for all of the workers present at any time.

5.8.2 Ambient Air Monitoring and Protection Limits

5.8.2.1 Perimeter Air Monitoring

In accordance with New York State Department of Economic Development (NYSDEC) and New York State Department of Health (NYSDOH) requirements for a Community Air Monitoring Plan (CAMP), a perimeter air-monitoring plan will be implemented at the site during each phase of the field activities. The objective of the perimeter air-monitoring plan is to provide a measure of protection for the downwind community (i.e., off-site receptors, including residences and businesses and on-site workers not involved with the site field activities) from potential airborne contaminant releases as a direct result of field activities. The perimeter air-monitoring response levels and actions are presented along with the work zone response levels and actions below. The perimeter air-monitoring plan is also presented as a stand-alone document that will be available on site and is presented in Appendix H.

Air monitoring stations will be established upwind and downwind of the work zone. VOCs and particulates (0.1-10 micrometer range) will be monitored at the upwind and downwind stations on a continuous basis. Wind direction will be determined using a wind sock(s) and/or flagging poles installed on site.

The perimeter air monitoring, Response Levels, and Actions are presented as follows.

VOC, Particulate, Hydrogen Cyanide, and LEL/O_2
Air Monitoring Response Levels and Actions

VOCs

Response Level	Actions
>5 ppm above background for 15-minute average	▪ Temporarily halt work activities ▪ Continue monitoring ▪ If VOC levels decrease (per instantaneous readings) below 5 ppm over background, work activities can resume ▪ If sustained VOC levels greater than 5 ppm over background, run chip measurement system (CMS) Draeger tube for benzene ▪ Continue work if CMS Draeger tube for benzene reads <0.5 ppm above background ▪ If CMS Draeger tube for benzene reads >0.5 ppm above background, stop work and investigate
Persistent levels >5 ppm over background <25 ppm	▪ Halt work activities ▪ Identify source of vapors ▪ Corrective action to abate emissions ▪ Continue monitoring ▪ Resume work activities if VOC levels 200 feet downwind of the property boundary or half the distance to the nearest potential receptor is <5 ppm for a 15-minute average ▪ If VOC levels are >25 ppm at the perimeter of the work area, activities must be shutdown

VOC, Particulate, Hydrogen Cyanide, and LEL/O_2 Air Monitoring Response Levels and Actions

Particulate	
>100 mcg/m3 above background for 15-minute average or visual dust observed leaving the site	▪ Apply dust suppression ▪ Continue monitoring ▪ Continue work if downwind PM-10 particulate levels are <150 mcg/m3 above upwind levels and no visual dust leaving site
>150 mcg/m3 above background for 15-minute average	▪ Stop work ▪ Re-evaluate activities ▪ Continue monitoring ▪ Continue work if downwind PM-10 particulate levels are <150 mcg/m3 above upwind levels and no visual dust leaving site
Hydrogen Cyanide Gas	
Note: No air purifying respiratory protection is available for hydrogen cyanide gas	
>1 ppm for 15-minute average using continuous meter	▪ Run CMS Draeger tube ▪ Continue monitoring ▪ Continue work if CMS (Chip Measurement System) Draeger tube for hydrogen cyanide reads <2 ppm
>2 ppm on CMS Draeger tube	▪ Stop work and move (with continuous monitoring meter) at least 25 feet up-wind from excavation or until continuous monitoring device registers <1 ppm ▪ Run CMS Draeger tube and Re-evaluate activities ▪ Continue monitoring ▪ Allow area to ventilate and continue to monitor while returning to the work zone. Do not move into an area when readings are >1 ppm without confirming with additional CMS draeger tube ▪ May resume work if Draeger tube for cyanide reads <2 ppm
Lower Explosive Limit/Oxygen	
<10% LEL	▪ Continue monitoring ▪ Continue work while evaluating/identifying potential ignitable vapor sources
>10% LEL	▪ Stop work and move out of work zone ▪ Shut off/remove all potential ignition sources in work zone ▪ Re-evaluate activities ▪ Return to work when readings are <10% LEL
>22% or <19.5% O_2	▪ Stop work and move out of work area ▪ Ventilate work zone and re-evaluate activities ▪ Return to work when readings are between <22% and >19.5%

Sources:

New York State Department of Health Community Air Monitoring Plan, June 20, 2000.

New York State Department of Environmental Conservation Division Technical and Administrative Guidance Memorandum - Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites, October 27, 1989.

5.8.2.2 Work Zone Air Monitoring

During excavating and materials handling operations, the air in work areas will also be sampled periodically for the presence of contaminants. A portable photoionization detector (PID) or flame ionization detector (FID) will be utilized to periodically monitor the levels of organic vapors in the ambient air and a Mini RAM^{TM} PM-10 (or equivalent) particle detector will be used to count inhalable particles (0.1-10 micrometer range) of dust during the field work.

VOC and particulate readings will be taken hourly during excavation or more frequently if air quality measurements approach action levels as defined herein. Lower explosive limit and oxygen levels will be monitored in the work zone using a portable LEL/$O_{2.}$ In addition, hydrogen cyanide gas will be monitored in the work zone continually using portable meter. Due to potential interference from sulfers, hydrogen sulfide gas will also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Draeger tubes due to this interference. Measurements will be monitored from the breathing zone (4 to 5 feet above ground level) at worker locations to determine working conditions (and whether there is a need to change levels of worker protection). In addition, VOCs, particulates, and hydrogen cyanide gas will also be monitored around the perimeter of the work zone on a regular basis (hourly) by the GEI air monitoring personnel.

In order to make a conservative assessment of when different levels of respiratory protection are needed during the field work, it will be assumed that the organic vapors detected by the air monitoring instruments consist of the most toxic volatile compounds expected to be found on the site. Preliminary evaluation of the risks expected at the site indicates that the most toxic volatiles that are probably present are VOCs (particularly BTEX). Based on data published by the OSHA and the American Conference of Government Industrial Hygienists (ACGIH), and GEI's experience with MGP wastes, the following PPE will be employed when the given concentrations of organic vapor are detected in the breathing zone.

Compound of Concern	**Level D**	**Level C**	**Level B**
Chemical Name	M<X	X<M<Y	M>Y
BTEX and other photoionizable VOCs	M <5 ppm	5 ppm <M <50 ppm	M >50 ppm

Where: M = concentration of organic vapor measured in the field
X,Y= concentrations at which different levels of respiratory protection are necessary.

The PPE requirements may be modified based on compound-specific monitoring results information, with the written approval of the Corporate Health and Safety Specialist (CHSS).

Respiratory protection from dusts will be required when inhalable particulate concentrations from potentially contaminated sources exceed 150 µg/m^3 sustained for a minute.

Odors or dusts derived from site contaminants may cause nausea in some site workers, even though the contaminants are at levels well below the safety limits as defined above. Workers may use dust masks or respirators to mitigate nuisance odors with the approval of the SSO.

Whenever practical, work areas should be positioned upwind of organic vapor and dust sources to reduce the potential for worker exposure.

5.9 Hearing Protection

Per OSHA regulation 29 CFR 1926.101, hearing protective devices will be provided to personnel working in areas of high decibel noise. Hearing protective devices will be worn during periods of high decibel noise exposure, as per 29 CFR 1926.52, Table D-2, Permissible Noise Exposures. Noise exposure will not exceed 85 decibels over an eight-hour day.

5.10 The "Buddy" System

The "buddy" system will be employed by site personnel when working under certain circumstances, such as enclosed spaces. Under the "buddy" system, each site worker is responsible for monitoring the well-being of another worker. No one works alone when the "buddy" system is implemented. At no time will fewer than two employees be present at the site if activities are underway.

5.11 Heat Stress Monitoring and Prevention

Wearing personal PPE puts site workers at risk of developing heat stress, which may result in health effects ranging from fatigue to serious illness to death. Heat stress is caused by the interplay of a variety of factors, including ambient conditions, workload, clothing, and the physical characteristics of each worker. The major symptoms of heat stress are listed below.

- ***Heat rash*** may result from prolonged exposure to heat or humid air.

- ***Heat cramps*** are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include: muscle spasms; and pain in the hands, feet and abdomen.

- ***Heat exhaustion*** occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include: pale, cool, moist skin; heavy sweating; dizziness; nausea; and fainting.

- ***Heat stroke*** is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are: red, hot, usually dry skin; lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse; and coma.

When the temperature in the work area is continuously at or above 70°F (21°C) for more than one hour, all workers wearing protective clothing (Level A, B, or C) will be monitored for heat stress during rest periods according to one of the following procedures.

- Take pulse over a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one third and keep the rest time the same. If, at the next rest period, the heart rate still exceeds 110 beats per minute, shorten the following work period again by one third. Continue the process as necessary.

- Take body temperature orally using a clinical thermometer kept under the tongue for three minutes. Take temperature at the end of each work cycle before drinking anything. If the temperature exceeds 99.6°F (37.6°C), shorten the next work period by one third without changing the rest period. If the temperature still exceeds 99.6°F at the beginning of the next rest period, shorten the following work cycle by one third. No worker will be permitted to wear a semi-permeable or impermeable garment if their temperature exceeds 100.6°F (38.1°C).

5.12 Effects of Cold Exposure and Their Prevention

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

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10 degrees Fahrenheit with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F.

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

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

- **Frost nip or incipient frostbite**: characterized by sudden blanching or whitening of the skin

- **Superficial frostbite**: skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient

- **Deep frostbite**: tissues are cold, pale, and solid; extremely serious injury

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in the following five stages.

- Shivering
- Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F
- Unconsciousness, glassy stare, slow pulse, and slow respiratory rate
- Freezing of the extremities
- Death

Standard reference books should be consulted for specific first-aid treatments. Medical help must be obtained for the more serious conditions. These effects of cold exposure shall be prevented by the wearing of appropriate clothing and by providing a warm “refuge” area where workers may warm up as necessary to prevent cold effects.

5.13 Indicators of Toxic Exposure

The following indicators of toxic exposure are generally observable by others and should be reported to the SSO if observed in a worker or personally experienced.

- Changes in complexion or skin discoloration
- Lack of coordination
- Changes in demeanor
- Excessive salivation, pupillary response
- Changes in speech pattern

The following symptoms of toxic exposure are generally non-observable by others, and should be reported to the SSO if experienced.

- Headaches
- Dizziness
- Blurred vision
- Nausea
- Cramps
- Irritation of eyes, skin, throat, or respiratory tract

The action to be taken by the SSO in response to any of these symptoms will be guided by the considerations covered in the Contingency Plan (subsection 3.6.3.5).

5.14 Precautions for Working in Confined Spaces

The investigations do not call for performing any specific work in confined spaces. However, if any work in confined spaces is required, it will be performed in accordance with 29 CFR 1910.146 and this HASP will be amended to address the work, as applicable. Confined space work will not be performed without first notifying and receiving written approval from the CHSS.

5.15 Fire Prevention

Special attention will be paid to fire prevention to avoid uncontrolled fires. The following fire prevention rules will be followed at the site.

- Smoking will be prohibited in all areas except those clearly designated and labeled as such by the PEC as smoking areas.

- All tanks, containers, and pumping equipment associated with the storage or handling of combustible or flammable liquids will be UL-listed for their intended use and in good condition.

- No sources of ignition will be permitted in areas where flammable or combustible liquids are stored. “NO SMOKING” signs will be placed in these areas.

- All lighting used in areas where flammable or combustible liquids are stored or used will be UL-listed.

- Delivery and storage of combustible or flammable liquids will be in keeping with state and federal Department of Transportation (DOT) regulations.

- Good housekeeping standards will be maintained including the removal of waste, rubbish, and rags daily.

5.16 Communication Procedures

Verbal communications and/or cellular telephones will be used at the Glen Cove former MGP site for communication between personnel. A cellular phone is also available for use at the designated on-site vehicle for communication with emergency support groups.

5.17 Decontamination Procedures

Decontamination areas will be established for personnel decontamination and equipment decontamination.

5.17.1 Personnel Decontamination Station

A personnel decontamination station where workers can drop equipment and remove PPE will be set up at the boundary of the restricted zones within active site work areas. It will be equipped with basins for water and detergent, and trash bag(s) or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will proceed to a sink where they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.)

The following specific decontamination procedure will be used as necessary by site workers wearing PPE from Level D through Level B.

- Step 1 - Equipment drop (SCBA, tools, monitoring equipment, etc.) Decontaminate as appropriate (per SSO's instructions).

- Step 2 - Boot wash/rinse (wash with non-foaming detergent, rinse with fresh water spray). If inner and outer gloves are worn, wash outer gloves, remove and save for later use, or remove and discard outer gloves and place in trash bag/can provided in the decontamination area.

- Step 3 - Hard hat removal, wash if visibly contaminated (use same wash as in Step 2).

- Step 4 - Remove boots. If Tyvek^{TM} (or equivalent) suit was worn and is visibly contaminated, remove and place in trash bag/can provided in the decontamination area or decontaminate (wash) and store for reuse. Contaminated washable coveralls should be removed and bagged for washing.

- Step 5 - Respirator and/or eye protection removal (as applicable). Wash (per Step 2) to remove visible contamination.

- Step 6 - Glove removal.

- Step 7 - Wash potentially exposed skin (use water and soap at indoor sink).

- Step 8 - Disinfect respirator per manufacturer's recommendations.

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate container) and disposed of in an approved facility. Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with all applicable state and federal regulations.

5.17.2 Heavy Equipment Decontamination

Heavy equipment decontamination will be performed within the limits of the on-site decontamination pads. A steam generator and brushes will be used to clean excavating equipment and other tools. No heavy equipment will be permitted to leave the site unless it has been thoroughly decontaminated.

Wastewater from the heavy equipment and personnel decontamination areas will be collected and disposed of in accordance with all applicable state and federal regulations. KeySpan will be responsible for ultimate disposal of investigation-derived wastes.

5.17.3 Sampling Equipment Decontamination

Sampling equipment will be decontaminated in accordance with the Work Plan. All of the sampling tools will be decontaminated at the end of the investigation before removal from the site or wrapped/bagged in plastic for transport and decontamination at the GEI Office.

5.17.4 Decontamination Equipment Requirements

The following equipment may be used to implement project decontamination procedures.

- Plastic trash barrels
- Liners for trash barrels
- Wash basins
- Alconox™ detergent concentrate
- Hand pump sprayers
- Long handle soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Acetone
- Nitric acid
- Steam generator
- Liquid detergent and paper towels
- Plastic trash bags
- Other

Subcontractors performing decontamination procedures are responsible for ensuring that the above materials, as required for their operation, are in sufficient supply.

5.18 Location of Buried Utilities

The footprint of the Glen Cove former MGP site is located within the current transformer substation. Thus, it will be necessary for the excavator and driller contractor to exercise a high degree of caution in determining the correct and safe location of each excavation/drilling area. LIPA will be asked to mark all of their electric facilities on the site. All borings will be hand-cleared or cleared with a utility clearance machine prior to drilling to assure that subsurface utilities are not damaged. All boring locations will be marked out prior to commencing work and the New York One Call utility service will be notified prior to commencing work.

5.19 Engineering Controls and Work Practices

Engineering controls and work practices specified by both OSHA and the United States Environmental Protection Agency (EPA) are directed primarily toward limiting exposure through the application of engineered barriers. These requirements apply to practices on

Superfund sites; however, they will also be applied to the Glen Cove former MGP site where/when appropriate and practical.

5.20 Waste Management

GEI personnel will inspect the waste storage area and document the conditions everyday. Documentation will be provided to KeySpan. Further details of waste management, sampling and labeling activities are discussed in the RI Work Plan.

5.21 Material Handling

Regulations for handling drums and containers are specified by OSHA 29 CFR 1910.120(j). Potential hazards associated with handling drums include vapor generation, fire, explosions, and possible physical injury. Whenever possible the material will be lifted and moved by mechanical devices rather than manual effort. These mechanical devices will be operated by trained authorized personnel only. Drum and container handling will be performed in accordance with all applicable regulations.

5.22 Mechanical Equipment

All hand and power tools will be maintained and used properly. Any damaged tools must be removed from the site until they are repaired. Removing any safety controls is prohibited. Electric hand tools must be double insulated or grounded with a ground-fault circuit interrupter.

5.23 Vehicle Management

All vehicles used to transport personnel, equipment or for soil hauling must be maintained and operated in a safe manner to protect workers and the public. Only properly trained and licensed personnel may operate vehicles.

5.24 Drilling and Earth-Moving Equipment Safety

Drilling and earth-moving equipment operators will be responsible for operating their assigned pieces of equipment according to the requirements outlined in 29 CFR 1926, Subpart O. Any pieces of equipment not satisfying the requirements of this section or otherwise unsafe to operate will not be used. The SSO will be apprised of the unsatisfactory condition of equipment as soon as possible. The equipment will be placed out-of-service and tagged to identify its safety failing until the equipment can be repaired, or decontaminated and demobilized from the site.

5.25 Traffic Hazards

Nearby moving vehicles are considered to be an extreme physical hazard due to the potential for accidents, injury, or death.

General Considerations on Sites In or Adjacent to Traffic

- All sites located on active roadways or parking lots shall follow the traffic control that is consistent with state and local traffic regulations (properly coned and/or barricaded prior to commencing work).
- Traffic shall be properly redirected around the work area. A police detail shall be on site for traffic control where applicable.
- A vehicle shall be used to block the work area from oncoming traffic when appropriate. The vehicle is to be parked at a safe distance from the work area in order to avoid personnel being struck by the blocking vehicle if hit by oncoming traffic. The vehicle's flashers or beacon shall be on for the duration of the operation being conducted in or adjacent to traffic.
- Workers shall wear high-visibility, reflective, vests when on a project with significant traffic, whether it be motor vehicle or heavy equipment.
- Face the traffic whenever possible. Never put your back to the flow of traffic when conducting or observing activities (i.e., groundwater sampling, observing soil borings/test pits).
- Conduct all field work using the buddy system.
- Look in the direction of oncoming traffic before crossing the roadway.
- When crossing the roadway, attempt to make eye contact with the operator of the oncoming motor vehicle. The operator will be more likely to slow down or stop, allowing ample time to cross the roadway in a safe manner.
- Avoid trips and falls in the roadway by walking, not running, on or across the roadway.
- Because of close proximity, work to the active rail line of the Long Island Railroad, all work completed adjacent to the railroad will comply with applicable Long Island

Railroad Safety Regulations. This can include the use of Long Island Railroad safety personnel, personal safety equipment, and training.

5.26 Sanitation for Temporary Work Sites

Sanitary facilities will be available at the Glen Cove former MGP site.

5.27 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. All field activities planned for the Glen Cove former MGP RI will occur outside during daylight hours. However, if yard areas are used after dark they will be equipped with illumination that meets or exceeds requirements specified in 29 CFR 1926.56, Illumination.

5.28 Site-Specific Safety Rules

The following site-specific rules and regulations will be enforced during the Glen Cove former MGP RI.

- No smoking, drinking, or eating within restricted zones.
- The on-site speed limit is 10 miles per hour.
- Proper respiratory protection is required to be worn at all times within zones where toxic vapor/gas levels have been determined to be above recommended safety limits. Copies of fit tests and medical clearance forms for each worker will be present on site.
- All rest, refreshment, and sanitary facility use will take place in “clean areas” outside of restricted and decontamination zones.
- Those in contact with contaminated soils or other materials that are thought to be contaminated must go through decontamination upon egress from the restricted area (based on the level of contamination) and before they may enter “clean” areas or non-restricted areas. Decontamination procedures are detailed in subsection 5.16.
- The SSO has full authority over start-up and shutdown of operations from a safety standpoint. He will determine whether conditions are too extreme for work, and he will establish the working hours at the site.

5.29 Conditions Reportable to the SSO

Any of the following conditions, or potential conditions, shall be immediately reported to the SSO:

- Fire and/or explosion
- Spill or release of potentially hazardous material
- Severe weather (e.g., electrical storm, tornado, etc.)
- Physical or chemical injuries, or hazards potentially causing injury to workers or the public
- Any other condition, potential event, or hazard posing a potential risk to human health or the environment

5.30 Emergency Evacuation Procedures

5.30.1 Site Evacuation Procedures

The SSO will act as the Project Emergency Coordinator (PEC) in the event of an emergency. If an emergency occurs that requires the evacuation of an area to ensure personnel safety, including (but not limited to) fire, explosion, severe weather, hazardous waste/materials spills, or a significant release of gas into the atmosphere, a horn will be sounded on the site by the nearest person aware of the event. The horn will sound continuously for approximately 15 seconds, signaling that immediate evacuation of all personnel from the area is necessary as a result of some existing or impending danger. In areas where only two or three people are working side by side, and the need to evacuate can be communicated verbally by the nearest person aware of the event, the air horn will not be necessary.

All heavy equipment in the area will be shut down. Under no circumstances will incoming visitors (other than emergency response personnel) be allowed to enter any area where an emergency is occurring. Visitors or observers and all non-essential personnel present in the area of an emergency will be instructed to evacuate the area immediately.

Contractor and subcontractor emergency coordinators and/or health and safety officers (as designated) will be responsible for ensuring that emergency response requirements specific to their own operations are carried out. These parties will report their activities to the PEC. However, the PEC has final authority regarding all emergency response activities.

All nonessential personnel shall evacuate the emergency areas and notify personnel in adjacent affected areas to evacuate. The evacuated workers will assemble at the primary assembly area located at the site entrance located on the southern side of the site on Grove Street.

Personnel are to avoid encountering smoke/gas plumes as practicable during evacuation and assembling.

The PEC will take charge of all emergency response activities and dictate the procedures that will be followed until emergency personnel arrive. The PEC will assess the seriousness of the situation, and direct whatever efforts are necessary until the emergency response units arrive.

After initiating emergency response procedures, the PEC will assign appropriate personnel to check and attempt to ensure that access roads are not obstructed. If traffic control is necessary, as in the event of a fire or explosion, personnel designated by the PEC will take over these duties until emergency units arrive. Appropriate reflective warning vests will be worn by personnel involved with traffic control. Vests, flares, flashlights, and traffic cones (or equivalent) as may be appropriate for traffic control will be kept available on site by the PEC.

The PEC will remain at the site to provide any assistance requested by emergency-response squads as they arrive to deal with the situation. The PEC will have the authority to shut down any part or the entire project after an emergency until he deems it safe to continue operations. He will dictate any changes in project safety practices, which are made necessary by the emergency that has occurred, or are required for preventing further emergencies.

5.30.2 Off-site Evacuation Procedures

If the PEC deems that humans outside of the site are at risk, he will notify the appropriate agencies and departments of the need or potential need to institute off-site evacuation procedures. The PEC will provide, at a minimum, the following information.

- His or her name and telephone number
- Name and address of facility
- Time and type of incident (i.e., release, fire, etc.)
- Name and quantity of materials or material involved, to the extent this information is known
- The extent of injuries, if any
- The possible hazards to human health or the environment, and cleanup procedures

6. Community Health and Safety Plan

This Community Health and Safety Plan (CHASP) addresses the health and safety practices that will be employed by all site workers participating in the Remedial Investigation (RI) to protect workers and residents located in the surrounding community. The former MGP is located in a highly developed area of Glen Cove, New York and is surrounded by a residential community to the south and east, a sports and fitness center to the north and east and two transportation corridors, the Long Island Rail Road and Route 107, to the north and west. Because of the proximity of the former MGP site to the local community, the following measures will be taken to avoid potential exposure from site related activities.

6.1 Overview of Planned Site Work

Work planned during the remedial investigation will result in minimal disruption and handling of MGP related contaminants. Investigations on the site will be conducted by advancing 2 to 4.25 inch borings through areas of suspected contamination that will be brought to the surface for inspection and laboratory analysis. No open excavations are planned during this phase of the investigation and all work is expected to be minimally intrusive. In order to prevent accidental exposure to site contaminants, soils and groundwater brought to the surface will be drummed once inspection and sampling activities are complete. Dust suppression techniques including covering all recovered soil and application of water to borehole equipment during drilling activities will be performed. To provide additional safeguards to the surrounding community, a Community Air Monitoring Program (CAMP) will be followed as described below.

6.2 Air Monitoring

In accordance with NYSDEC and NYSDOH requirements, a CAMP will be implemented at the site during each phase of the intrusive field activities. The objective of the CAMP is to provide a measure of protection for the downwind community (i.e., off-site receptors, including residences and businesses and on-site workers not involved with site RI activities) from potential airborne contaminant releases as a direct result of intrusive RI activities. Air monitoring stations will be located up-wind and downwind of each intrusive work area (i.e., boring locations). Volatile organic compounds (VOCs) and respirable particulates (PM-10) will be monitored at the stations on a continuous basis. Wind direction will be determined using a wind sock(s) and/or flagging poles installed on site. Hand-held equipment will be used to monitor VOCs, particulates, and cyanide in the work zone. VOCs, particulates, and cyanide will also be monitored around the perimeter of the work zone on a regular basis (hourly) by the field personnel. The VOC monitoring, response levels, and actions are presented in CAMP, which is located in Appendix E of the RIWP.

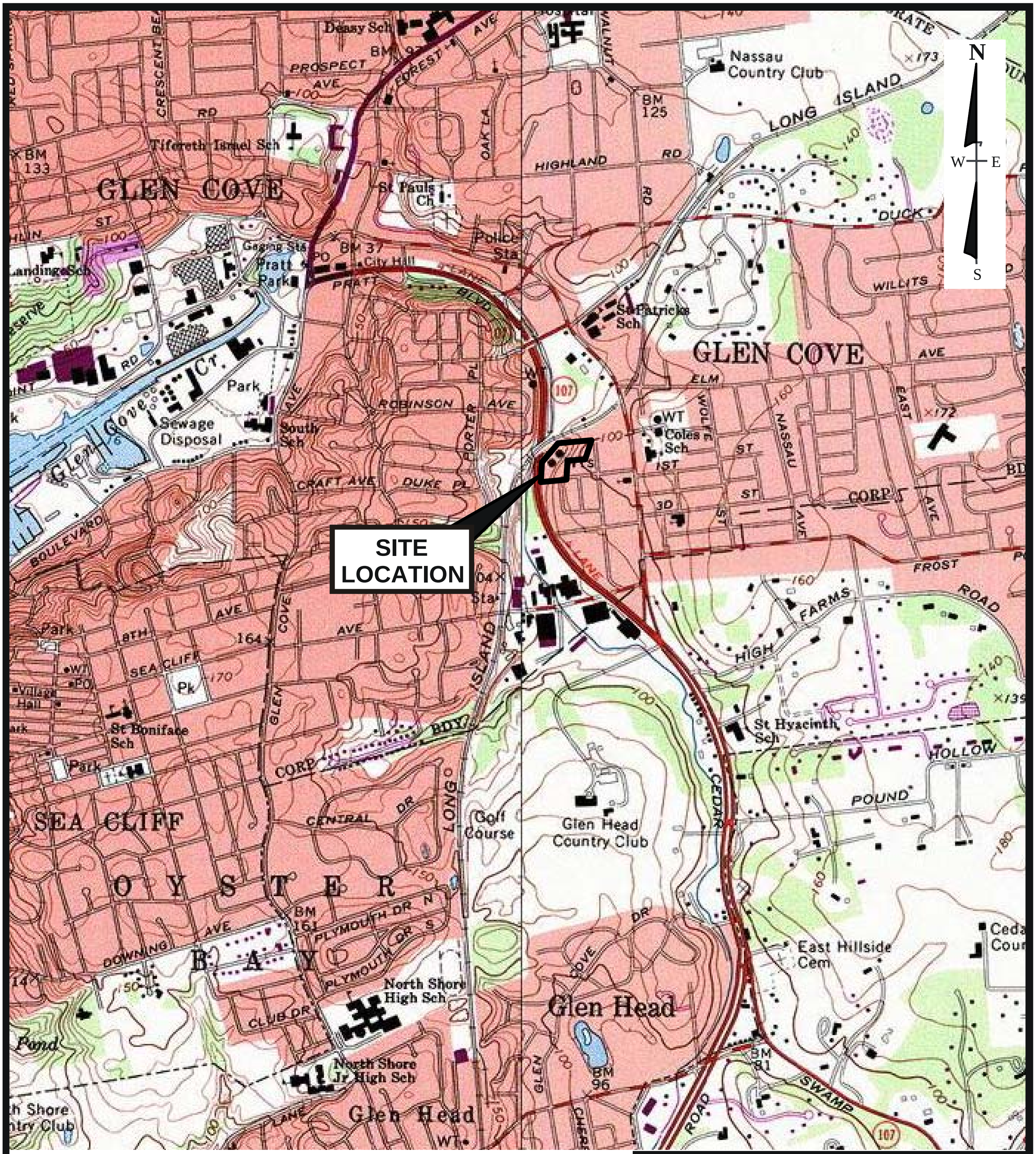
VOC vapors will be monitored using a photoionization detector (PID). Particulate dust will be monitored using a Miniram particulate meter. The Drager MiniWarn monitoring equipment for cyanide and will be verified by the use of Drager® tubes for cyanide. The PID and Miniram monitoring equipment will be calibrated at least daily.

7. Signatures of Field Team Members and Observers

The Site Safety Plan for the Glen Cove former MGP RI has been read by:

Name (Please Print)	Date	Firm	Signature	Copy (check if received)

Figures



2000 1000 0 2000 4000

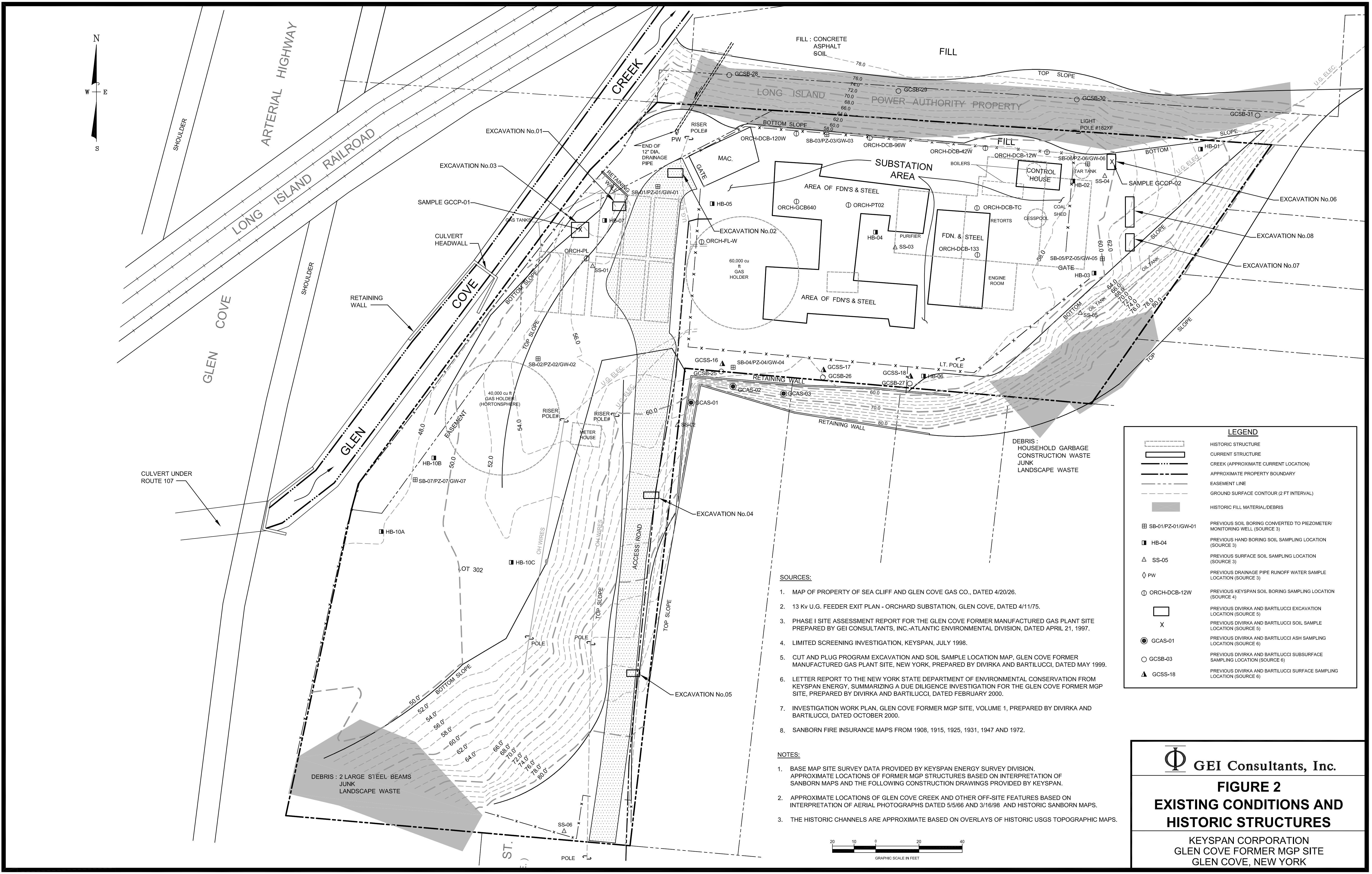
GRAPHIC SCALE IN FEET

SOURCE: MAP CREATED WITH TOPO!™ ©2000 WILDFLOWER PRODUCTIONS (www.topo.com)

Φ GEI Consultants, Inc.

FIGURE 1
SITE LOCATION MAP

KEYSPAN CORPORATION
GLEN COVE FORMER MGP SITE
GLEN COVE, NEW YORK



LEGEND

▭	HISTORIC STRUCTURE
▭	CURRENT STRUCTURE
━ ··· ━	CREEK (APPROXIMATE CURRENT LOCATION)
━ ‒ ‒ ━	APPROXIMATE PROPERTY BOUNDARY
── ‒ ‒ ‒ ──	EASEMENT LINE
‒ ‒ ‒ ‒ ‒ ‒	GROUND SURFACE CONTOUR (2 FT INTERVAL)
▨	HISTORIC FILL MATERIAL/DEBRIS
⊞ SB-01/PZ-01/GW-01	PREVIOUS SOIL BORING CONVERTED TO PIEZOMETER/ MONITORING WELL (SOURCE 3)
◨ HB-04	PREVIOUS HAND BORING SOIL SAMPLING LOCATION (SOURCE 3)
△ SS-05	PREVIOUS SURFACE SOIL SAMPLING LOCATION (SOURCE 3)
◊ PW	PREVIOUS DRAINAGE PIPE RUNOFF WATER SAMPLE LOCATION (SOURCE 3)
⦶ ORCH-DCB-12W	PREVIOUS KEYSPAN SOIL BORING SAMPLING LOCATION (SOURCE 4)
▭	PREVIOUS DIVIRKA AND BARTILUCCI EXCAVATION LOCATION (SOURCE 5)
X	PREVIOUS DIVIRKA AND BARTILUCCI SOIL SAMPLE LOCATION (SOURCE 5)
◉ GCAS-01	PREVIOUS DIVIRKA AND BARTILUCCI ASH SAMPLING LOCATION (SOURCE 6)
○ GCSB-03	PREVIOUS DIVIRKA AND BARTILUCCI SUBSURFACE SAMPLING LOCATION (SOURCE 6)
▲ GCSS-18	PREVIOUS DIVIRKA AND BARTILUCCI SURFACE SAMPLING LOCATION (SOURCE 6)

SOURCES:

1. MAP OF PROPERTY OF SEA CLIFF AND GLEN COVE GAS CO., DATED 4/20/26.
2. 13 Kv U.G. FEEDER EXIT PLAN - ORCHARD SUBSTATION, GLEN COVE, DATED 4/11/75.
3. PHASE I SITE ASSESSMENT REPORT FOR THE GLEN COVE FORMER MANUFACTURED GAS PLANT SITE PREPARED BY GEI CONSULTANTS, INC.-ATLANTIC ENVIRONMENTAL DIVISION, DATED APRIL 21, 1997.
4. LIMITED SCREENING INVESTIGATION, KEYSPAN, JULY 1998.
5. CUT AND PLUG PROGRAM EXCAVATION AND SOIL SAMPLE LOCATION MAP, GLEN COVE FORMER MANUFACTURED GAS PLANT SITE, NEW YORK, PREPARED BY DIVIRKA AND BARTILUCCI, DATED MAY 1999.
6. LETTER REPORT TO THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION FROM KEYSPAN ENERGY, SUMMARIZING A DUE DILIGENCE INVESTIGATION FOR THE GLEN COVE FORMER MGP SITE, PREPARED BY DIVIRKA AND BARTILUCCI, DATED FEBRUARY 2000.
7. INVESTIGATION WORK PLAN, GLEN COVE FORMER MGP SITE, VOLUME 1, PREPARED BY DIVIRKA AND BARTILUCCI, DATED OCTOBER 2000.
8. SANBORN FIRE INSURANCE MAPS FROM 1908, 1915, 1925, 1931, 1947 AND 1972.

NOTES:

1. BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION. APPROXIMATE LOCATIONS OF FORMER MGP STRUCTURES BASED ON INTERPRETATION OF SANBORN MAPS AND THE FOLLOWING CONSTRUCTION DRAWINGS PROVIDED BY KEYSPAN.
2. APPROXIMATE LOCATIONS OF GLEN COVE CREEK AND OTHER OFF-SITE FEATURES BASED ON INTERPRETATION OF AERIAL PHOTOGRAPHS DATED 5/5/66 AND 3/16/98 AND HISTORIC SANBORN MAPS.
3. THE HISTORIC CHANNELS ARE APPROXIMATE BASED ON OVERLAYS OF HISTORIC USGS TOPOGRAPHIC MAPS.

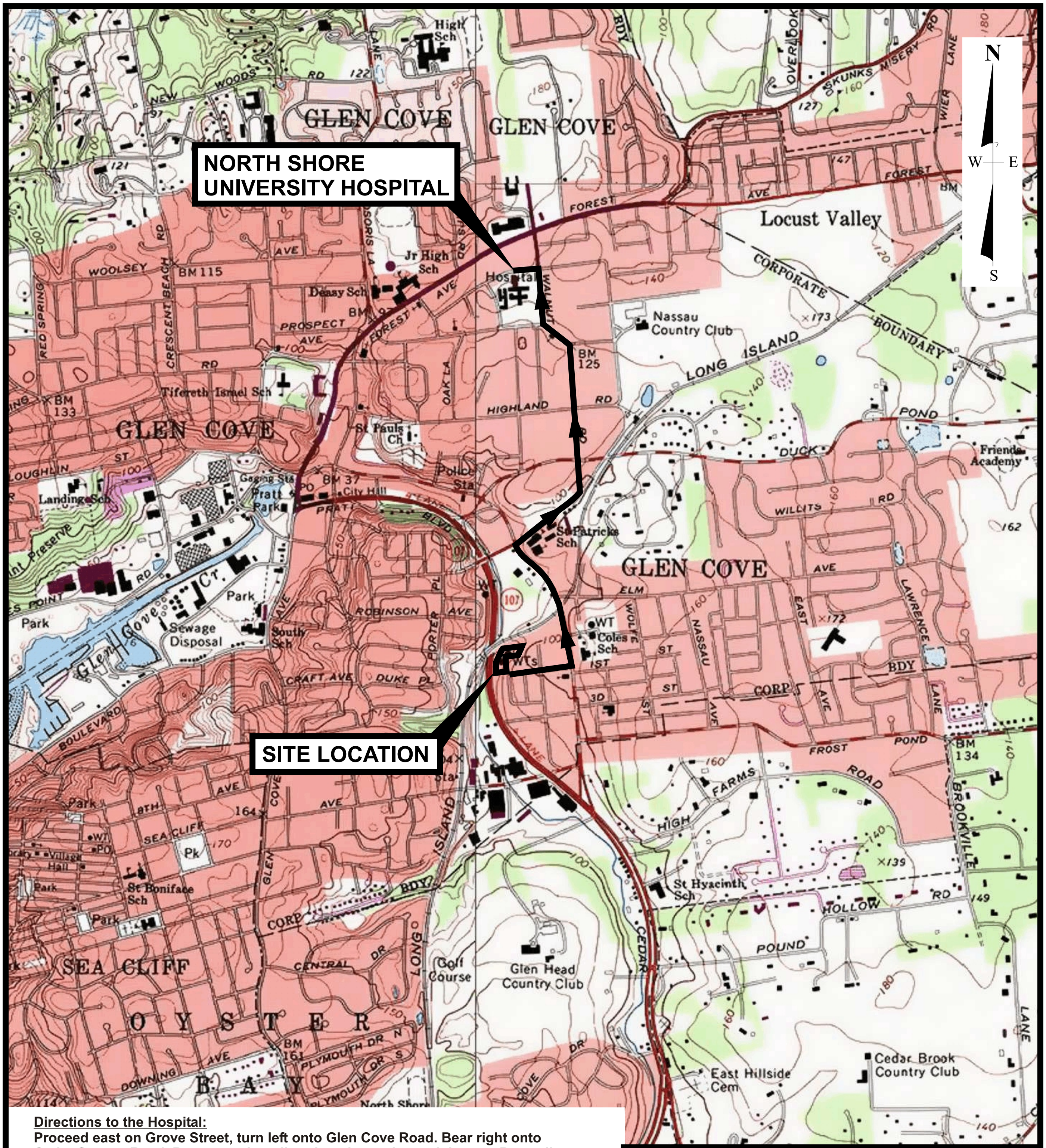
20 10 0 20 40
GRAPHIC SCALE IN FEET

Φ GEI Consultants, Inc.

FIGURE 2
EXISTING CONDITIONS AND HISTORIC STRUCTURES

KEYSPAN CORPORATION
GLEN COVE FORMER MGP SITE
GLEN COVE, NEW YORK

GEI\KEYSPAN\GLENCOVE\WP\FIG\GLEN-EXIST



Directions to the Hospital:

Proceed east on Grove Street, turn left onto Glen Cove Road. Bear right onto Cedar Swamp Road. Pass over the railroad tracks, and turn right onto Pearsall Avenue. Follow the blue hospital signs, bearing left onto Walnut Road. The hospital is on the left-hand side. To reach the main entrance, turn left at the traffic light onto St. Andrews Lane.

2000 1000 0 2000 4000

GRAPHIC SCALE IN FEET

SOURCE: MAP CREATED WITH TOPO!™ 2000 WILDFLOWER PRODUCTIONS (www.topo.com)

GEI Consultants, Inc.

FIGURE 3
ROUTE TO THE HOSPITAL MAP

KEYSPAN CORPORATION
GLEN COVE FORMER MGP SITE
GLEN COVE, NEW YORK

Appendix A

Medical Testing/Screening

Critical information on reverse

HEALTH RESOURCES

Three Hundred Four Cambridge Road
Woburn, Massachusetts 01801

Health Resources
Employee Medical Scheduling Sheet
GEI Consultants

Section I: To be provided to clinic.

Employee Name		GEI Employee ID#:	
Clinic Name:	ConnCare at the William Backus Hospital	GEI Location:	Colcester CT
Clinic Address:	326 Washington Street Norwich, CT 06360	Date of Last Exam:	
		Apt. Date & Time: ________________	
Clinic Phone:	860-823-6509		

Section II: Employee Instructions.

1. Please complete General Medical Questionnaire and bring both the questionnaire and this form with you to your appointment.
2. If you wear eyeglasses, please bring them with you.
3. Remember that you will be asked to leave a urine sample.
4. Your blood work includes a test for cholesterol and triglycerides. It is not required to fast for these tests, but the results are most accurate if you can fast 12-14 hours prior to your appointment.
5. Please avoid loud environments such as certain motorcycles or loud music for 14 hours before your exam. If loud environments cannot be avoided, hearing protection (plugs, muffs, etc.) must be worn during the work period prior to the exam.

If you have any questions regarding your exam, please feel free to call Health Resources at 1-(800) 350-4511.

A complete summary letter including glossary of terms will be mailed to your home address following your exam. If you require a complete copy of your medical file, please check here. ☐

Section III: To be completed by GEI Manager or designee.

Type of Exam:

Hazmat and Non-Hazmat Examination

☐ **Baseline Exam** - ☐ **Exit Exam**
When checked, complete all of the following:

- Medical and Occupational Health Questionnaire
- MD Examination
- Vital Signs
- Height & Weight
- EKG age 50+ on baseline exam only
- Complete Vision
- Audiometry (500-8000 Hz)
- Pulmonary Function Test
- Blood and Urine Collection for (Health Resources LabCorp Blood/ Urine - fill all tubes)
    - Chemzyme Plus
    - CBC with differential
    - Complete Urinalysis

☐ **Hazmat Annual Exam** - *When When checked, complete all of the following:*

- Periodic Medical History
- MD Examination
- Vital Signs
- Height & Weight
- Complete Vision
- Audiometry (500-8000 Hz)
- Pulmonary Function Test
- Blood and Urine Collection for
- (Health Resources LabCorp Blood/
- Urine - fill all tubes)
    - Chemzyme Plus
    - CBC with differential
    - Complete Urinalysis

☐ **Non-Hazmat Annual**
When checked, complete all of the following:

- Periodic Medical History
- MD Examination
- Vital Signs
- Height & Weight
- Complete Vision
- Audiometry (500-8000 Hz)
- Pulmonary Function Test

Additional Exam Elements: (To be performed on an as directed basis or of medically indicated. Health Resources must authorize).

☐ RBC Cholinesterase
☐ Lead Level - Blood
☐ Heavy Metal Screen (Urine)
☐ Chest X-ray (PA & Lateral)
☐ Tetanus Vaccine
☐ EKG
☐ PCB

"Proven Leadership in Occupational Health and Management"

Appendix B

Occupational Health Guidelines and Material Safety Data Sheets

Occupational Health Guideline for Cyanide

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all cyanides. Physical and chemical properties of two specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Potassium cyanide

- Formula: KCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

Sodium cyanide

- Formula: NaCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cyanide is 5 milligrams of cyanide per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to a ceiling of 5 milligrams cyanide per cubic meter of air averaged over a 10-minute period. The NIOSH Criteria Document for Hydrogen Cyanide and Cyanide Salts should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Cyanide can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. Sufficient cyanide may be absorbed through the skin, especially if there are cuts to cause fatal poisoning.

- **Effects of overexposure**

1. Short-term Exposure: Inhalation or ingestion of cyanide salts may be rapidly fatal. Larger doses by inhalation or swallowing may cause the person to rapidly lose consciousness, stop breathing, and die. In some cases, there are convulsions. At lower levels of exposure, the earlier symptoms include weakness, headache, confusion, nausea, and vomiting. These symptoms may be followed by unconsciousness and death. Occasionally, convulsions occur. Milder forms of intoxication may result only in weakness, dizziness, headache, and nausea. The dust of cyanide salts is irritating to the eyes. In the presence of tears, it may cause the symptoms of poisoning described above. The dust of cyanide salts may produce irritation of the nose and skin. Strong solutions of cyanide salts are corrosive and may produce ulcers.

2. Long-term Exposure: Effects from chronic exposure to cyanide are non-specific and rare.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to cyanide.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to cyanide at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of fainting spells, such as occur in various types of cardiovascular and nervous disorders.

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

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

explosions. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide and carbon monoxide) may be released when cyanide decomposes.

4. Special precautions: Cyanide may react with carbon dioxide in ordinary air to form toxic hydrogen cyanide gas.

- **Flammability**

1. Not combustible

- **Warning properties**

1. Odor Threshold: No quantitative information is available concerning the odor threshold of sodium or potassium cyanide. HCN, however, is evolved from these substances in the presence of moisture. The Manufacturing Chemists Association states that "although HCN has a characteristic odor, its toxic action at hazardous concentrations is so rapid that it is of no value as a warning property."

2. Eye Irritation Level: Cyanide (as CN) is not known to be an eye irritant. However, according to Grant, HCN can produce eye irritation after chronic exposures.

3. Evaluation of Warning Properties: Although cyanide (as CN) has a negligible vapor pressure, in the presence of moisture HCN can be given off. HCN does not have adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of cyanide. Each measurement should consist of a ten (10) minute sample or series of consecutive samples totalling ten (10) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of cyanide with a cellulose membrane filter and an impinger containing sodium hydroxide, followed by analysis by direct potentiometry. An analytical method for cyanide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with cyanide or liquids containing cyanide.
- If employees' clothing has had any possibility of being contaminated with cyanide, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing which has had any possibility of being contaminated with cyanide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of cyanide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyanide, the person performing the operation should be informed of cyanide's hazardous properties.
- Where there is any possibility of exposure of an employee's body to cyanide or liquids containing cyanide, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with cyanide should be removed immediately and not reworn until the cyanide is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of cyanide or liquids containing cyanide contacting the eyes.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.
- If cyanide is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner for reclamation, or for treatment in a cyanide disposal system.

- Waste disposal method:

After treatment as in above, cyanide may be disposed of in a secured sanitary landfill.

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Agency

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Michigan, Minnesota,
Ohio, Wisconsin

EPA Facts About Ferric Ferrocyanide

What Is Ferric Ferrocyanide?

Ferric ferrocyanide is an intense blue pigment known by many names, including Prussian Blue, Berlin Blue, Chinese Blue, Hamburg Blue, Mineral Blue, Paris Blue, Iron Blue, and others. Ferric ferrocyanide is a compound manufactured from iron cyanide salts.

Ferric ferrocyanide is a major component of the blue residue found at manufactured gas sites. Until the 1950s gas for cooking and lighting in homes was made by passing steam over red hot coke under pressure. Cyanide contaminants in the manufactured gas were removed by passing the gas through a bed of woodchips and iron filings. This process generated ferric ferrocyanide, locally known as gas wash.

Ferric ferrocyanide has been used commercially as a pigment in printing inks, paints, leather cloth, carbon paper, typewriter ribbons, plastics, paper dye, laundry bluing, fertilizers, and cosmetics such as eye shadow. Ferric ferrocyanide has also been used as an anticaking agent in products such as road salt. Medically, ferric ferrocyanide has been used to treat radiation exposure and metal poisoning.

This fact sheet summarizes readily available information about ferric ferrocyanide. For more information, please contact U.S. EPA directly at the appropriate toll-free number:

MI, IN, MN, OH, WI Residents	Residents of Illinois
1-800-621-8431	1-800-572-2515
Monday - Friday	Monday - Friday
9 a.m. - 4:30 p.m.	9 a.m. - 4:30 p.m.
Central Time	Central Time

How are People Exposed to Ferric Ferrocyanide?

People are exposed to ferric ferrocyanide during its manufacture and use, and through contact with products into which the dye has been incorporated. People also may be exposed to ferric ferrocyanide through its medical uses and through contact with waste products from manufactured gas sites.

What Potential Health Threats are Associated With Ferric Ferrocyanide?

Ferric ferrocyanide is a very stable compound that does not dissolve in water or oil. Therefore, it is not readily absorbed through the skin or in the digestive tract. In ferric ferrocyanide the cyanide is strongly bound to the rest of the molecule and therefore acts very differently than free cyanide.

Based on studies of related compounds, ferric ferrocyanide probably has a low toxicity when taken orally in high doses. Ferric and ferrocyanides (which are less chemically stable than ferric ferrocyanide) have LD 50 values for rats above 1 gram (g)/kilogram (kg). This means, on average, one-half of the rats fed greater than 1 g of the compound per kg of body weight will die. Tests of ferric and ferrocyanides have also been performed on mice and dogs, with similar results. These compounds are considered 100 to 5,000 times less toxic than free cyanide.

In people, low doses of ferric ferrocyanides have been given as medication and in clinical tests without harmful affects. In one case, a 52 -year-old man ingested a large dose (more than one ounce) of ferrocyanide, which caused serious kidney problems, but he survived. There is no indication that skin irritation due to ferrocynides, including ferric ferrocyanide, is a concern.

Although ferric ferrocyanide probably has a low toxicity, care should be used in its presence. Under extreme conditions, highly toxic decomposition products including free cyanide, can form. In addition, when ferric ferrocyanide is found in manufactured gas plant waste, there may be low levels of other hazardous contaminants.

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the oral cavity, respiratory tract, bladder, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders, for premalignant and malignant lesions, and evidence of hyperpigmentation or photosensitivity.

—Urinalysis: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. A urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment, as well as a test for red blood cells.

—Urinary cytology: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. Employees having 5 or more years of exposure or who are 45 years of age or older should have a urinary cytology examination.

—Sputum cytology: Coal tar pitch volatiles are associated with an excess of lung cancer. Employees having 10 or more years of exposure or who are 45 years of age or older should have a sputum cytology examination.

—14" x 17" chest roentgenogram: Coal tar pitch volatiles are associated with an excess of lung cancer. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Coal tar pitch volatiles are reported to cause an excess of bronchitis. Periodic surveillance is indicated.

—A complete blood count: Due to the possibility of benzene exposure associated with coal tar pitch volatiles, a complete blood count is considered necessary to search for leukemia and aplastic anemia.

—Skin disease: Coal tar pitch volatiles are defatting agents and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of these agents.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis, and semi-annually for employees 45 years of age or older or with 10 or more years' exposure to coal tar pitch volatiles.

- **Summary of toxicology**

Coal tar pitch volatiles (CTPV) are products of the destructive distillation of bituminous coal and contain polynuclear aromatic hydrocarbons (PNA's). These hydrocarbons sublime readily, thereby increasing the amounts of carcinogenic compounds in working areas. Epidemiologic evidence suggests that workers intimately exposed to the products of combustion or distillation of bituminous coal are at increased risk of cancer at many sites. These include cancer of the respiratory tract, kidney, bladder, and skin. In a study of coke oven workers, the level of exposure to CTPV and the length of time exposed were related to the development of cancer. Coke oven workers with the highest risk of cancer were those employed exclusively at topside jobs for 5 or more years, for whom the increased risk of dying from lung cancer was 10-fold; all coke oven workers had a 7-½-fold increase in risk of dying from kidney cancer. Although the causative agent or agents of the cancer in coke oven workers is unidentified, it is suspected that several PNA's in the CTPV generated during the coking process are involved. Certain industrial populations exposed to coal tar products have a demonstrated risk of skin cancer. Substances containing PNA's which may produce skin cancer also produce contact dermatitis; examples are coal tar, pitch, and cutting oils. Although allergic dermatitis is readily induced by PNA's in guinea pigs, it is only rarely reported in humans from occupational contact with PNA's; these have resulted largely from the therapeutic use of coal tar preparations. Components of pitch and coal tar produce cutaneous photosensitization; skin eruptions are usually limited to areas exposed to the sun or ultraviolet light. Most of the phototoxic agents will induce hypermelanosis of the skin; if chronic photodermatitis is severe and prolonged, leukoderma may occur. Some oils containing PNA's have been associated with changes of follicular and sebaceous glands which commonly take the form of acne. There is evidence that exposures to emissions at coke ovens and gas retorts may be associated with an increased occurrence of chronic bronchitis. Coal tar pitch volatiles may be associated with benzene, an agent suspected of causing leukemia and known to cause aplastic anemia.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data—Anthracene**

1. Molecular weight: 178.2
2. Boiling point (760 mm Hg): 340 C (644 F)
3. Specific gravity (water = 1): 1.24
4. Vapor density (air = 1 at boiling point of anthracene): 6.15
5. Melting point: 217 C (423 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Phenanthrene**

1. Molecular weight: 178.2
2. Boiling point (760 mm Hg): 340 C (644 F)
3. Specific gravity (water = 1): 1.18
4. Vapor density (air = 1 at boiling point of phenanthrene): 6.15
5. Melting point: 100.5 C (213 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Pyrene**

1. Molecular weight: 202.3
2. Boiling point (760 mm Hg): Greater than 360 C (greater than 680 F)

should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of coal tar pitch volatiles from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the coal tar pitch volatiles, the person performing the operation should be informed of coal tar pitch volatiles's hazardous properties.

- Employees should be provided with and required to use splash-proof safety goggles where condensed coal tar pitch volatiles may contact the eyes.

SANITATION

- Workers subject to skin contact with coal tar pitch volatiles should wash with soap or mild detergent and water any areas of the body which may have contacted coal tar pitch volatiles at the end of each work day.
- Employees who handle coal tar pitch volatiles should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.
- Areas in which exposure to coal tar pitch volatiles may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to coal tar pitch volatiles may occur and control methods which may be effective in each case:

Operation	Controls
Liberation from extraction and packaging from coal tar fraction of coking	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a binding agent in manufacture of coal briquettes used for fuel; use as a dielectric in the manufacture of battery electrodes, electric-arc furnace electrodes, and electrodes for alumina reduction	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture of roofing felts and papers and roofing	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use for protective coatings for pipes for underground conduits and drainage; use as a coating on concrete as waterproofing and corrosion-resistant material; use in road paving and sealing	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture and repair of refractory brick; use in production of foundry cores; use in manufacture of carbon ceramic items	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If condensed coal tar pitch volatiles get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with these chemicals.

- **Skin Exposure**

If condensed coal tar pitch volatiles get on the skin, wash the contaminated skin using soap or mild detergent and water. Be sure to wash the hands before eating or smoking and to wash thoroughly at the close of work.

- **Breathing**

If a person breathes in large amounts of coal tar pitch volatiles, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed.
- If coal tar pitch volatiles are released in hazardous concentrations, the following steps should be taken:

1. Ventilate area of spill.

RESPIRATORY PROTECTION FOR COAL TAR PITCH VOLATILES

Condition	Minimum Respiratory Protection* Required Above 0.2 mg/m³
Particulate and Vapor Concentration	
2 mg/m³ or less	A chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high-efficiency filter. Any supplied-air respirator. Any self-contained breathing apparatus.
10 mg/m³ or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high-efficiency filter. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and with a full facepiece and a fume or high-efficiency filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
200 mg/m³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. A powered air-purifying respirator with an organic vapor cartridge and a high-efficiency particulate filter.
400 mg/m³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 400 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

naphtha. However, exposure to high concentrations might be expected to cause lightheadedness, drowsiness, and possibly irritation of the eyes, nose, and throat. Repeated or prolonged contact with the liquid may result in drying and cracking skin due to defatting action. Coal tar (naphtha) is a non-uniform mixture of aromatic hydrocarbons and may contain benzene.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 110 (approximately)
2. Boiling point (760 mm Hg): 110 to 190 C (230 to 374 F)
3. Specific gravity (water = 1): 0.97
4. Vapor density (air = 1 at boiling point of coal tar naphtha): 3 (approximately)
5. Melting point: Data not available
6. Vapor pressure at 20 C (68 F): Less than 5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Greater than 1

- **Reactivity**

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving coal tar naphtha.
4. Special precautions: Coal tar naphtha will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Flash point: 38 to 43 C (100 to 109 F) (closed cup)
2. Autoignition temperature: 482 to 510 C (900 to 950 F)
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Dry chemical, foam, carbon dioxide

- **Warning properties**

1. Odor Threshold: Since the odor thresholds of the main constituents of coal tar naphtha are below their permissible exposure limits, the odor threshold of coal tar naphtha is assumed to be below the permissible exposure limit.
2. Eye Irritation Level: According to Grant, Gafafer states that the naphthas cause conjunctival irritation. Two of the main constituents of coal tar naphtha, xylene and toluene, cause noticeable eye irritation at concentrations of 200 and 300 ppm, respectively.
3. Evaluation of Warning Properties: Since the odor threshold of the main constituents of coal tar naphtha are well below their permissible exposure limits, coal tar naphtha is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Sampling and analyses may be performed by collection of coal tar naphtha vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure coal tar naphtha may be used. An analytical method for coal tar naphtha is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).
026).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid coal tar naphtha.
- Clothing wet with liquid coal tar naphtha should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of

clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. Coal tar naphtha should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- Waste disposal methods:

Coal tar naphtha may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Naphtha (Coal Tar)," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
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Occupational Health Guideline for Hydrogen Cyanide

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: HCN
- Synonyms: Hydrocyanic acid; prussic acid; formonitrile
- Appearance and odor: Colorless or pale blue liquid or gas with a bitter almond odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for hydrogen cyanide is 10 parts of hydrogen cyanide per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 11 milligrams of hydrogen cyanide per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be reduced to 5 mg cyanide/m^3 averaged over a 10-minute period. The NIOSH Criteria Document for Hydrogen Cyanide and Cyanide Salts should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Hydrogen cyanide can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

1. *Short-term Exposure:* Inhalation, ingestion, or skin absorption of hydrogen cyanide may be rapidly fatal. Larger doses may cause the person to rapidly lose consciousness, stop breathing, and die. At lower levels of exposure, a person may experience weakness, headache, confusion, nausea, and vomiting. These symptoms may be followed by unconsciousness and death. Hydrogen cyanide liquid may irritate the eyes.

2. *Long-term Exposure:* Effects from chronic exposure to hydrogen cyanide are non-specific and rare.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to hydrogen cyanide.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to hydrogen cyanide at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of fainting spells, such as occur in various types of cardiovascular and nervous disorders, and and those who are unusually susceptible to effects of anoxia or with anemia would be expected to be at increased risk from exposure. Examination of the cardiovascular, nervous, and upper respiratory systems, and thyroid should be stressed.

—Cardiovascular disease: Persons with cardiac disease may be at increased risk. An electrocardiogram should be performed on workers over 40 years of age and where indicated.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis.

3. *First Aid Kits:* First aid kits should be immediately available in workplaces where there is a potential for the release of hydrogen cyanide. These kits should contain a minimum of 48 ampules, each of 0.3 ml amyl nitrate, and complete instructions for use. In addition, 2 physician's kits should be immediately available to trained medical personnel. These kits should contain the above quantity of amyl nitrate as well as sterile sodium

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of hydrogen cyanide. Each measurement should consist of a ten (10) minute sample or series of consecutive samples totalling ten (10) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Hydrogen cyanide may be monitored by collection in midget impingers containing sodium hydroxide, followed by analysis with an ion specific electrode. An analytical method for hydrogen cyanide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid hydrogen cyanide.
- Where there is any possibility of exposure of an employee's body to liquid hydrogen cyanide, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Any clothing which becomes wet with, or non-impervious clothing which becomes contaminated with, liquid hydrogen cyanide should be removed immediately and not reworn until the hydrogen cyanide is removed from the clothing.
- Clothing wet with hydrogen cyanide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of hydrogen cyanide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the hydrogen cyanide, the person performing the operation should be informed of hydrogen cyanide's hazardous properties.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid hydrogen cyanide contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to hydrogen cyanide, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with hydrogen cyanide should be immediately washed or showered to remove any hydrogen cyanide.
- Employees who handle hydrogen cyanide should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to hydrogen cyanide may occur and control methods which may be effective in each case:

Operation	Controls
Use in fumigation of structures and agricultural crops	Process enclosure; local exhaust ventilation; personal protective equipment
Liberation during use of cyanide salts or solutions in metal treatment operations, blast furnace and coke oven operations, metal ore processing, and photoengraving operations	Process enclosure; local exhaust ventilation; personal protective equipment
Use in production of intermediates in synthesis of acrylic plastics, nylon 66, chelating agents, dyes, pharmaceuticals, and specialty chemicals	Process enclosure; local exhaust ventilation; personal protective equipment

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RESPIRATORY PROTECTION FOR HYDROGEN CYANIDE

Condition	**Minimum Respiratory Protection* Required Above 5 ppm**
Vapor Concentration	
50 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 50 ppm** or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against hydrogen cyanide. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of hydrogen cyanide; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 50 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

sion, excitement, malaise, profuse sweating, nausea, vomiting, abdominal pain, and irritation of the bladder; there may be progression to jaundice, hematuria, hemoglobinuria, renal tubular blockage, and acute renal shutdown. Hematologic features include red cell fragmentation, icterus, severe anemia with nucleated red cells, leukocytosis, and dramatic decreases in hemoglobin, hematocrit, and red cell count; sometimes there is formation of Heinz bodies and methemoglobin. Individuals with a deficiency of glucose-6-phosphate dehydrogenase in erythrocytes may be more susceptible to hemolysis by naphthalene. Cataracts and ocular irritation have been produced experimentally in animals and have been described in humans; of 21 workers exposed to high concentrations of fume or vapor for 5 years, 8 had peripheral lens opacities; in other studies no abnormalities of the eyes have been detected in workers exposed to naphthalene for several years. The vapor causes eye irritation at 15 ppm; eye contact with the solid may result in conjunctivitis, superficial injury to the cornea, chorioretinitis, scotoma, and diminished visual acuity. Naphthalene on the skin may cause hypersensitivity dermatitis; chronic dermatitis is rare.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 128.2
2. Boiling point (760 mm Hg): 218 C (424 F)
3. Specific gravity (water = 1): 1.14
4. Vapor density (air = 1 at boiling point of naphthalene): 4.4
5. Melting point: 74 – 80 C (165 – 176 F)
6. Vapor pressure at 20 C (68 F): 0.05 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.003
8. Evaporation rate (butyl acetate = 1): Much less than 1

- **Reactivity**

1. Conditions contributing to instability: None.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as dense acrid smoke and carbon monoxide) may be released in a fire involving naphthalene.
4. Special precautions: Melted naphthalene will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Flash point: 79 C (174 F) (closed cup)
2. Autoignition temperature: 526 C (979 F)
3. Flammable limits in air, % by volume: Lower: 0.9; Upper: 5.9
4. Extinguishant: Carbon dioxide, dry chemical, foam

- **Warning properties**

1. Odor Threshold: The AIHA *Hygienic Guide* reports that the odor threshold of naphthalene is "at least as low as 0.3 ppm."
2. Eye Irritation Level: The *Hygienic Guide* states that "naphthalene vapor is reported to cause eye irritation at 15 ppm or above in air."
3. Evaluation of Warning Properties: Through its odor and irritant effects, naphthalene can be detected at or below the permissible exposure limit. Naphthalene, therefore, is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure naphthalene may be used. An analytical method for naphthalene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

one else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.
- If naphthalene is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber.

- Waste disposal methods:

Naphthalene may be disposed of:

1. By making packages of naphthalene in paper or other flammable material and burning in a suitable combustion chamber.
2. By dissolving naphthalene in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber.

ADDITIONAL INFORMATION

To find additional information on naphthalene, look up naphthalene in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

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Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

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

Section 1. Material Identification 32

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

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

NFPA

HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

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

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

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

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

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

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

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

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

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8

Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
% Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

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

Section 4. Fire and Explosion Data

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

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

Section 5. Reactivity Data

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

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Material Safety Data Sheets Collection:

Sheet No. 409
Cresol (Mixed Isomers)

Issued: 12/78 Revision: B, 3/92

Section 1. Material Identification

37

Cresol, *mixed isomers* ($CH_3C_6H_4OH$) Description: Derived from coal tar or petroleum. Cresol is marketed by individual isomer and as pure or crude cresol. Pure cresol is a mixture of *ortho*, *meta*, and *para* isomers. Crude cresol (commercial cresol) is prepared by distilling "grey phenic acid" at 356 to 401 °F (180 to 205 °C) and is comprised of 20% *ortho*, 40% *meta*, and 30% *para* isomers, plus small amounts of phenol and xylenols. Each isomer can be prepared synthetically by diazotization of the specific corresponding toluidine. Used in manufacturing synthetic resins, explosives, photographic developers, petroleum, paint, disinfectants, and fumigants; as an ore flotation agent; and in the agriculture industry for herbicides and insecticides.
Other Designations: CAS No. 1319-77-3, Bacillol, cresylic acid, Tekresol, tricresol.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Cresol is severely irritating to mucous membranes, eyes, and skin. Depending on the cresol concentration, extent of exposure, and amount of skin exposed, toxicity may be slight (irritation) or severe (permanent injury or death).

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

NFPA
2
3 0

HMIS
H 3
F 2
R 0
PPG†
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Cresol (*mixed isomers*) National Formulary (NF) grade contains < 5% phenol

1990 OSHA PEL (Skin)
8-hr TWA: 5 ppm (22 mg/m³)

1990 NIOSH REL
TWA: 5 ppm (22 mg/m³)

1990 IDLH Level
250 ppm

1991-92 ACGIH TLV (Skin)
TWA: 5 ppm (22 mg/m³)

1990 DFG (Germany) MAK
TWA: 5 ppm (22 mg/m³) (H)*
Peak Exposure Limit: 10 ppm, 5 min, momentary value/8 per shift

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 1454 mg/kg; toxic effects not yet reviewed
Mouse, inhalation, LC_{50}: 179 mg/m³/2 hr; no toxic effects noted (*o*-)
Rabbit, eye: 103 mg produced severe irritation (*p*-)
Rabbit, skin: 517 mg applied for 24 hr produced severe irritation (*m*-)
Rabbit, skin, LD_{50}: 2000 mg/kg; toxic effects not yet reviewed

* Danger of cutaneous absorption.
† See NIOSH, *RTECS* (GO5950000), for additional toxicity data. For data on specific isomers, see *RTECS* (GO6125000, *meta*; GO6300000, *ortho*; and GO6475000, *para*).

Section 3. Physical Data

Boiling Point Range: 375.8 to 397.4 °F (191 to 203 °C)
Melting Point Range: 51.8 to 95 °F (11 to 35 °C)
Vapor Pressure: 0.25 (*ortho*), 0.15 (*meta*), 0.11 (*para*) mm Hg at 68 °F (20 °C)
Vapor Density (air = 1): 3.72
pH: Saturated solutions are neutral or slightly acidic to litmus
Viscosity: 4.49 to 7.0 cP at 104 °F (40 °C)
Molecular Weight: 108.13
Specific Gravity: 1.030 to 1.038 at 77 °F (25 °C)
Water Solubility: Soluble, 1%
Other Solubilities: Soluble in alcohol, ether, dilute alkalies, glycol and vegetable oils
Refraction Index: 1. 5353 at 75.2 °F (24 °C)
Odor Threshold: Low, 0.012 mg/m³; high, 22 mg/m³

Appearance and Odor: Colorless, yellow, or pinkish liquid turning brown on exposure to air or light with a phenolic odor and pungent taste.

Section 4. Fire and Explosion Data

Flash Point: 178 °F (81.11 °C, *ortho*), 187 °F (86.11 °C, *meta* and *para*), CC	**Autoignition Temperature:** 1110 °F (559 °C, *ortho*), 1038 °F (558 °C, *meta* and *para*)	**LEL:** 1.4% (*ortho*), 1.1% (*meta* and *para*) at 302 °F (150 °C)	**UEL:** None reported

Extinguishing Media: While cresol does not ignite easily, it burns. For small fires, use dry chemical, carbon dioxide (CO_2), water spray, or regular foam. For large fires, use water spray, fog, or regular foam. Do not scatter material with more water than is necessary to put out fire.
Unusual Fire or Explosion Hazards: Container may explode in heat of fire.
Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is ineffective for fires involving cresol. Use clothing the manufacturer recommends specifically for use with cresol. If possible without risk, remove container from fire area. Fight fire from maximum distance. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Cresol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Cresol reacts with oxidizing materials and causes a temperature and pressure increase with chlorosulfonic acid, nitric acid, and oleum.
Conditions to Avoid: Ignition sources and contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of cresol can produce carbon dioxide (CO_2) and toxic cresol fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(142) and OSHA(164) do not list cresol as a carcinogen. **Summary of Risks:** Cresol is corrosive to eyes, skin, and mucous membranes. Degree of toxicity depends on the cresol concentration involved, amount of surface area exposed, and duration of exposure. Ingestion is corrosive to the digestive tract's mucous membranes and can pose serious problems if not treated promptly. Because cresol has a low vapor pressure, it is not volatile enough under normal conditions to present an inhalation hazard. If heated, vapor inhalation is likely. Severe chemical burns and dermatitis are the main hazards in industry. Note that cresol's *ortho* and *para* isomers (if used individually) are in crystal form and thus are a dust inhalation hazard. By all routes of exposure, cresol produces toxic symptoms similar to phenol's. **Medical Conditions Aggravated by Long-Term Exposure:** Skin diseases. **Target Organs:** Eyes, skin, central nervous system (CNS), liver and kidney. **Primary Entry Routes:** Skin and eye contact/absorption. **Acute Effects:** Cresol is absorbed through skin, open wounds, and the mucous membranes of the respiratory and digestive tracts. The rate at which skin absorbs cresol depends more on the size of exposure area than on the concentration of material applied. Cresol is corrosive to the skin causing smarting; tingling; redness; swelling; burns that may be very painful and become white and wrinkled with softening that may become gangrenous; blisters; possible shock as a result

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Material Safety Data Sheets Collection:

Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

39

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

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.

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

NFPA

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

Section 2. Ingredients and Occupational Exposure Limits

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

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

1990 IDLH Level
2000 ppm

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

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

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

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

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

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm
Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0768 lb/ft^3 or 1.2298 kg/m^3

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

Section 4. Fire and Explosion Data

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

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

Section 5. Reactivity Data

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

Section 6. Health Hazard Data

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

Continue on next page

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Material Safety Data Sheet Collection

Methanol **MSDS No. 354**

Date of Preparation: 11/77 Revision: E, 3/98

Section 1 - Chemical Product and Company Identification

Product/Chemical Name: Methanol **Chemical Formula:** CH_4O or CH_3OH **CAS Number:** 67-56-1

Synonyms: carbinol; Coat-B1400; Colonial Spirits; Columbian Spirit; EPA pesticide chemical code 053801; methyl alcohol: methyl hydrate; methyl hydroxide; monohydroxymethane; pyroligneous spirit; pyroxylic spirit; pyroxylic spirits; Surflo-B17; wood alcohol; wood naphtha; wood spirit

Derivation: Prepared by wood pyrolysis; non-catalytic oxidation of hydrocarbons; as a by-product in the fisher-tropsch synthesis; or by reduction of carbon monoxide.

General Use: Used as an industrial solvent; starting material for organic synthesis; antifreeze for windshield washer fluid; in fuel antifreezes; gasoline octane booster; fuel for stoves; extractant for oils; denaturing ethanol; softening agent; food additive; in paint, varnish removers, and embalming fluids; in the manufacture of photographic film, celluloid, textile soap, wood stains, coated fabrics, shatterproof glass, paper coating, waterproofing formulations, artificial leather, dyes.

Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Methanol, ca 100% vol

Trace Impurities (Grade A): Acetone and aldehydes < 30 ppm, acetic acid < 30 ppm

OSHA PELs

8- hr TWA: 200 ppm (260 mg/m^3)

Vacated 1989 Final Rule Limits:

TWA: 200 ppm (260 mg/m^3)

STEL: 250 ppm (325 mg/m^3)

ACGIH TLVs*

TWA: 200 ppm (262 mg/m^3), *Skin*

STEL: 250 ppm (328 mg/m^3)

NIOSH REL

10- hr TWA: 200 ppm (260 mg/m^3), *Skin*

STEL: 250 ppm (325 mg/m^3)

IDLH Level

6000 ppm

DFG (Germany) MAK

TWA: 200 ppm (260 mg/m^3), *Skin*

Category II, 1: Substances with systemic effects; onset of effect ≤ 2 hr; half life < 2 hr

Embryo/Fetus Risk of Damage Classification C†

Peak Exposure Limit:

400 ppm (520 mg/m^3), 30 min, average value, 4/shift

*There are also ACGIH Biological Exposure Indices (BEIs™).

†There is no reason to fear risk of damage to developing embryo or fetus when MAK or BAT values are observed.

Section 3 - Hazards Identification

ANSI Signal Word: Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Methanol is a colorless liquid with a slight alcohol odor when pure, or disagreeably pungent odor when crude. It is irritating to the eyes, skin, and respiratory tract. Exposure may result in headache, visual disturbance, blindness, and respiratory failure. Reproductive effects have been reported in animal testing. This flammable liquid is a moderate explosion hazard. When heated to decomposition, methanol emits carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Wilson Risk Scale

R	1
I	3
S	2*
K	3

*Skin absorption

HMIS

H	2*
F	3
R	0

PPE†

*Chronic effects

†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption

Target Organs: Eyes, skin, central nervous system (CNS), gastrointestinal (GI) tract, respiratory system

Acute Effects

Inhalation: Irritation, breathing difficulty, headache, drowsiness, vertigo, light-headedness, nausea, vomiting, acidosis (decreased blood alkalinity), visual disturbance, and at high concentrations, CNS damage, convulsions, circulatory collapse, respiratory failure, coma and blindness can result from inhalation of methanol vapor. Concentration ≥ 200 ppm may cause headache; 50,000 ppm can cause death within 1-2 hrs. **Eye:** Contact with liquid may result in irritation, inflamed lids, light sensitization, and superficial lesions. **Skin:** Contact may cause irritation, dermatitis, swelling, scaling, and systemic effects listed under inhalation. **Ingestion:** GI irritation and systemic effects (see Inhalation). Symptoms may be delayed 18-48 hours. Fatal dose: 2-8 ounces.

Carcinogenicity: IARC, NTP, and OSHA do not list methanol as a carcinogen. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Chronic Effects:** Exposure to methanol vapors has caused conjunctivitis, headache, giddiness, insomnia, GI disturbance, impaired vision. CNS damage is also likely. Methanol is slowly eliminated from the body; exposure is considered cumulative over the short term.

or other positive-pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For escape, use an appropriate escape-type SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Protective Clothing/Equipment:** Wear chemically protective gloves, boots, aprons, and gauntlets of butyl rubber, Teflon™, Viton™, Saranex™, 4H™, Responder™, Trellchem HPS™, or Tychem 10000™ (Breakthrough Time (BT) >8 hr) to prevent skin contact. Natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl alcohol and CPF 3™ may degrade after contact and are not recommended. Wear splash-proof chemical safety goggles, and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, washing facilities available in work area. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance and Odor: Colorless; slight alcohol odor when pure, disagreeably pungent odor when crude
Odor Threshold Range: 13.1150 to 26840 mg/m^3
Vapor Pressure: 127 mm Hg at 77 °F (25 °C)
Vapor Density (Air=1): 1.11
Saturated Vapor Density (air=1.2 kg/m^3, 0.075 lb./ft^3): 1.221 kg/m^3
Formula Weight: 32.04
Density: 0.796 g/mL at 59 °F (15 °C)
Specific Gravity (H_2O=1, at 4 °C): 0.81 at 0 °C/4 °C
Bulk Density: 6.59 lbs/gal at 68 F (20 °C)
pH: Slightly acidic

Water Solubility: Miscible
Other Solubilities: Ethanol, acetone, benzene, chloroform, DMSO, ether, ketones, most organic solvents.
Boiling Point: 148 °F (64.7 °C) at 760 mm Hg
Freezing Point: -144.04 °F (-97.8 °C)
Viscosity: 0.614 mPa sec
Refractive Index: 1.3292 at 68 °F (20 °C)/D
Surface Tension: 22.61 dynes/cm
Ionization Potential (eV): 10.84
Henry's Law Constant (H): 4.55 x10^{-6} atm-m^3/mole at 77 °F (25 °C)
Octanol/Water Partition Coefficient: log K_{ow} = -0.77
Soil Sorption Coefficient (log K_{oc}): 0.44

Section 10 - Stability and Reactivity

Stability: Methanol is stable at room temperature in closed containers under normal storage and handling conditions. **Polymerization:** Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include beryllium dihydride, metals (potassium, magnesium), oxidants (barium perchlorate, bromine, chlorine, hydrogen peroxide, sodium hypochlorite, phosphorus trioxide), potassium tertbutoxide, carbon tetrachloride and metals, chloroform and heat, diethyl zinc, alkyl aluminum salts, acetyl bromide, chloroform and sodium hydroxide, cyanuric chloride, nitric acid, chromic anhydride, lead perchlorate. **Conditions to Avoid:** Vapor inhalation, oxidizers. **Hazardous Decomposition Products:** Thermal oxidative decomposition of methanol can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Section 11- Toxicological Information

Toxicity Data:*

Reproductive Effects:

Rat (female), oral: 7500 mg/kg, administered during gestational days 17-19 produced effects on newborn - behavioral.

Rat (female), oral: 35295 mg/kg administered during gestational days 1-15 produced effects on the fertility index; pre-implantation mortality; and post-implantation mortality.

Rat (female), inhalation: 20000 ppm/7 hr, administered during gestational days 1-22 produced specific developmental abnormalities - musculoskeletal system; cardiovascular (circulatory) system; urogenital system.

Rat (male), oral: 200 ppm/20 hr, 78 weeks prior to mating produced paternal effects - testes, epididymis, sperm duct.

Multiple Dose Toxicity Data:

Rat, oral: 12 g/kg/8 weeks intermittently produced toxic effects: behavioral - ataxia; behavioral - alteration of operant conditioning.

Rat, inhalation: 50 mg/m^3/12 hr/13 weeks intermittently produced degenerative changes to brain and coverings; muscle contraction or spasticity.

Rat, inhalation: 2610 ppm/6 hr/4 weeks intermittently produced toxic effects: endocrine - changes in spleen weight.

Eye Effects:

Rabbit, standard Draize test: 100 mg/24 hr resulted in moderate irritation.

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Material Safety Data Sheet Collection

Naphthalene **MSDS No. 624**

Date of Preparation: 11/87 Revision: A, 9/97

Section 1 - Chemical Product and Company Identification 50

Product/Chemical Name: Naphthalene

Chemical Formula: $C_{10}H_8$

CAS Number: 91-20-3

Synonyms: Albocarbon; camphor tar; Dezodorator; Mighty 150; moth balls; moth flakes; naftalen (Polish); naphthalin; naphthaline; naphthalinum; naphthene; NTM; tar camphor; white tar

Derivation: From coal tar; from petroleum fractions after various catalytic processing operations.

General Use: Used as a moth repellent, an antiseptic, toilet bowl deodorant, heat transfer agent, fungicide, smokeless powder, cutting fluid, lubricant, wood preservative; an intermediate for naphthol, phthalic anhydride, chlorinated naphthalenes, Tertralin, Decalin, naphthyl and naphthol derivatives, and dyes; in synthetic resins, synthetic tanning, textile chemicals, scintillation counters, and emulsion breakers.

Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Naphthalene, ca 100% wt. Grade: By melting point, 165 °F (74 °C) min (crude) to greater than 174 °F (79 °C) (refined); scintillation 176-177 °F (80-81 °C)

OSHA PELs	ACGIH TLVs	NIOSH RELs	IDLH Level
8-hr TWA: 10 ppm (50 mg/m^3); *Vacated 1989 Final Rule Limit:* 15-min. STEL: 15 ppm (79 mg/m^3)	TWA: 10 ppm (52 mg/m^3) STEL: 15 ppm (79 mg/m^3)	10-hr TWA: 10 ppm (50 mg/m^3); 15-min. STEL: 15 ppm (75 mg/m^3)	500 ppm **DFG (Germany) MAK** 10 ppm (50 mg/m^3)

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Naphthalene is a white crystalline solid with a 'moth ball' or coal-tar odor. It is toxic by ingestion. Irritating to skin, eyes, and respiratory system. Naphthalene is a combustible solid. Dust may form explosive mixtures in air if subjected to an ignition source.

Wilson Risk Scale

R	1
I	3
S	2*
K	2

*Skin absorption

HMIS

H	2†
F	2
R	0

PPE‡

†Chronic Effects

‡Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, skin absorption, skin and/or eye contact

Target Organs: Blood (red blood cell effects), eyes, skin, central nervous system (CNS), liver and kidneys

Acute Effects

Inhalation: Vapor inhalation causes headache, confusion, nausea, sometimes vomiting, loss of appetite, extensive sweating, dysuria (painful urination), hematuria (blood in the urine), and hemolysis (destruction of red blood cells).

Eye: Irritation, conjunctivitis, and corneal injury upon prolonged contact.

Skin: Irritation and hypersensitivity dermatitis.

Ingestion: Unlikely. However, ingestion causes irritation of the mouth and stomach, hemolytic anemia with hepatic and renal lesions and vesical congestion, kidney failure, hematuria, jaundice, depression of CNS, nausea, vomiting, abdominal pain, blue face, lips, or hands, rapid and difficult breathing, headache, confusion, excitement, malaise, fever, perspiration, urinary tract pain, dizziness, convulsions, coma, and death. Symptoms may appear 2 to 4 hours after exposure.

Carcinogenicity: IARC, NTP, and OSHA do not list naphthalene as a carcinogen. EPA-D, Not Classifiable as to Human Carcinogenicity; MAK-B, Justifiably suspected of having carcinogenic potential; TLV-A4, Not Classifiable as a Human Carcinogen.

Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver and kidneys; individuals with a hereditary deficiency of the enzyme glucose-6-phosphate dehydrogenase in red blood cells are particularly susceptible to the hemolytic properties of naphthalene metabolites.

Chronic Effects: May cause optical neuritis, corneal injuries, cataracts, kidney damage.

Other: There are two reports of naphthalene crossing the placenta in humans.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor and dust dispersion into the work area. Ventilate at the site of chemical release. During the fractional distillation of naphthalene and in any operation entailing the heating or volatilization of naphthalene, enclosed apparatus should be employed.

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

Administrative Controls: Educate workers about the health and safety hazards associated with naphthalene. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the eyes, skin, liver, kidneys, CBC (RBC count, WBC count, differential count of a stained smear, hemoglobin, and hematocrit), and urinalysis including at a minimum specific gravity, albumin, glucose, and a microscopic examination on centrifuged sediment.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Teflon® is recommended. *Do not* use butyl rubber, natural rubber, neoprene or polyvinyl chloride. Wear chemical dust-proof safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

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

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove naphthalene from your shoes and clean personal protective equipment.

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

Section 9 - Physical and Chemical Properties

Physical State: Crystalline solid

Appearance and Odor: White, volatile flakes, cakes, cubes, spheres, or powder; strong coal-tar or moth ball odor

Odor Threshold: 0.084 ppm to 0.3 ppm

Vapor Pressure: 0.05 mm Hg at 68 °F (20 °C); 1.0 mm Hg at 127 °F (53 °C)

Formula Weight: 128.2

Density: 1.145 g/cm^3 at 68 °F (20 °C)

Saturated Vapor Concentration: 100 ppm at 77 °F (25 °C) (approx.)

Water Solubility: Insoluble [31.7 mg/L at 68 °F (20 °C)]

Other Solubilities: Benzene, absolute alcohol; very soluble in ether, chloroform, carbon disulfide, hydronaphthalenes, fixed and volatile oils

Boiling Point: 424 °F (218 °C)

Melting Point: 176 °F (80.2 °C)

Volatility: Volatilizes appreciably at room temperature. volatile with steam

Octanol/Water Partition Coefficient: log K_{ow} = 3.30

Section 10 - Stability and Reactivity

Stability: Naphthalene is stable at room temperature in closed containers under normal storage and handling conditions. It volatilizes at room temperature.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include aluminum chloride, benzoyl chloride, chromic acid, chromium trioxide, oxidizers. Explosive reaction with dinitrogen pentaoxide. Melted naphthalene will attack some forms of plastics.

Conditions to Avoid: Exposure to heat and ignition sources, incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of naphthalene can produce toxic fumes including carbon monoxide.

Section 11- Toxicological Information

Toxicity Data:*

Acute Effects:

Human (child), oral, LD_{Lo}: 100 mg/kg

Man, unreported, LD_{Lo}: 74 mg/kg

Rat, oral, LD_{50}: 490 mg/kg

Reproductive Effects:

Rat, oral: 4500 mg/kg administered on gestational days 6-15 produced fetotoxicity and other developmental abnormalities.

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Material Safety Data Sheets Collection:

Sheet No. 355
Phenol

Issued: 9/80 **Revision: C, 11/90**

Section 1. Material Identification 33

Phenol (C_6H_5OH) Description: One of many aromatic compounds in coal tar. Made by alkylating benzene with propylene then oxidizing the resulting cumene to produce phenol and acetone. Used as a feedstock in manufacturing various phenolic resins, caprolactum, bis-phenol-A, and other chemicals and drugs; a disinfectant; a fuel-oil sludge inhibitor; a reagent in chemical analysis; in producing or manufacturing a large variety of aromatic compounds including fertilizers, illuminating gas, coke, explosives, lampblack, paints, paint removers, asbestos goods, wood preservatives, textiles, perfumes, bakelite, rubber, and other plastics; in medical and industrial organic compounds and dyes; and in germicidal paints and slimicides. Phenol has been identified in cigarette smoke and automobile exhaust.

Other Designations: CAS No. 0108-95-2, carbolic acid, hydroxybenzene, monohydroxy benzene, oxybenzene, phenic acid, phenyl alcohol, phenyl hydroxide.

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

Cautions: Phenol has a marked corrosive effect on any tissue. Eye contact may cause severe damage and *blindness*. Its primary entry route is through *skin absorption*. Systemic absorption may cause *liver and kidney damage, convulsions (seizures), or death.*

R	1
I	4
S	3*
K	2

* Skin absorption

NFPA
2
3 0
-

HMIS

H	3
F	2
R	0
PPG†	

† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Phenol, ca 100%

1989 OSHA PEL (Skin)
8-hr TWA: 5 ppm, 19 mg/m^3

1990-91 ACGIH TLV (Skin)
TWA: 5 ppm, 19 mg/m^3

1988 NIOSH REL
TWA: 5 ppm, 19 mg/m^3
Ceiling: 15.6 ppm, 60 mg/m^3

1985-86 Toxicity Data*
Mammal, inhalation, LC_{50}: 74 mg/m^3
Rat, oral, LD_{50}: 317 mg/kg; toxic effects include behavorial changes (convulsions or effect on seizure threshold)
Rabbit, eye, TC_{Lo}: 5 mg produces severe irritation

1987 IDLH Level
250 ppm

* See NIOSH, *RTECS* (SJ3325000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 359.15 °F (181.75 °C) at 760 mm Hg
Melting Point: 109.4 °F (43 °C)
Vapor Pressure: 0.3513 mm Hg at 77 °F (25 °C)
Vapor Density (Air = 1): 3.24
pH: 6 (aqueous solution)
Molecular Weight: 94.11
Specific Gravity (20 °C/4 °C): 1.0576
Water Solubility: 1 g dissolves in about 15 ml H_2O
Viscosity: 12.7 centipoise at 64.9 °F (18.3 °C)

Appearance and Odor: White crystalline solid with a characteristic sharp medicinal sweet, tangy odor detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities or is exposed to heat or light.

Section 4. Fire and Explosion Data

Flash Point: 175 °F (79 °C), CC	**Autoignition Temperature:** 1319 °F (715 °C)	**LEL:** 1.7% v/v	**UEL:** 8.6% v/v

Extinguishing Media: Use water spray, carbon dioxide, dry chemical, or alcohol-type foam to extinguish fires involving phenol. Do not use a solid stream of water since the stream scatters and spreads fire. Use water spray to cool fire-exposed tanks/containers.

Unusual Fire or Explosion Hazards: Phenol presents a moderate fire hazard when exposed to heat, flame, or oxidizers. When heated, it emits toxic fumes and vapors that form explosive mixtures with air. Air mixtures containing 3 to 10% phenol are explosive. Solid phenol burns with difficulty, giving off heavy smoke.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. Be aware of runoff from fire control methods. Water containing phenol can cause severe chemical burns. Do not release to sewers or waterways.

Section 5. Reactivity Data

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

Chemical Incompatibilities: In general, phenol is incompatible with strong oxidizing agents and halogens. It coagulates colodion and proteins. A potentially explosive reaction occurs with formaldehyde, peroxydisulfuric acid, peroxymonosulfuric acid, sodium nitrite + heat, and aluminum chloride + nitromethane (at 110 °C/100 bar). A violent reaction occurs with butadiene, sodium nitrite + trifluoroacetic acid, and aluminum chloride + nitrobenzene at 248 °F (120 °C). Combining phenol with mineral oxidizing acids results in fire; with acetaldehyde results in violent condensation; with isocyanates results in heat generation and violent polymerization, with calcium hypochlorite results in an exothermic reaction producing toxic fumes which may ignite; and with nitrides results in heat and flammable gas generation. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium, and zinc. Reaction with these materials causes phenol to discolor.

Conditions to Avoid: Avoid heating phenol above 122 °F (90 °C).

Hazardous Products of Decomposition: Thermal oxidative decomposition of phenol can produce oxides of carbon and water.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list phenol as a carcinogen. Although no specific evidence of human cancer exists, its carcinogenicity to mice emphasizes the need for precaution when handling this material. Phenol also causes human mutations (genetic changes).

Summary of Risks: Phenol is a general protoplasmic poison that is corrosive to any living tissue it contacts. Toxicity most likely results from dermal (skin) contact or ingestion. Skin absorption occurs readily with a rapid onset of symptoms or death (within 30 min to several hours). Contact with eyes may cause severe damage and blindness. Ingestion of 1 g may be fatal. Although phenol is irritating to the respiratory tract, due to its low volatility and good warning properties, inhalation is typically less of a concern. Chronic toxic effects are uncommon, but may include digestive disturbances, neurological disorders, skin rash (dermatitis), and liver and kidney damage.

Medical Conditions Aggravated by Long-Term Exposure: Individuals with chronic respiratory disorders, pre-existing skin disorders, convulsive disorders, or kidney or liver abnormalities may be at increased risk from phenol exposure.

Target Organs: Liver, kidneys, nervous system, and skin.

Primary Entry Routes: Skin absorption, eye contact, ingestion, and inhalation.

Acute Effects: Skin contact results in white, wrinkled discoloration, followed by a severe burn or systemic poisoning if removed improperly.

Continue on next page

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Material Safety Data Sheets Collection:

Sheet No. 351
Styrene *monomer*

Issued: 8/79 Revision: D, 6/92

Section 1. Material Identification

38

Styrene *monomer* ($C_6H_5CHCH_2$) **Description:** Produced by catalytic dehydrogenation of ethylbenzene at 932 to 1292 °F (500 to 700 °C) at 30 mm Hg; catalyst is a mixture of zinc oxide (86%), aluminum, calcium, and magnesium. Available in technical (99.2% pure) and polymer (99.6% pure) grades. Occurs naturally in the sap of styracaceous plants, in pyrolysis and cracking products of petroleum derivatives, in bituminous-coal and shale-oil tars, in rubber latexes, and as a product of organic substance pyrolysis. Used in the manufacture of a wide range of polymers including polystyrene and copolymer elastomers such as butadiene-styrene rubber or acrylonitrile-butadiene-styrene (ABS); in production of plastics and insulators, as a resin modifying additive, dental filling component, chemical reaction intermediate, and in agricultural products.

Other Designations: CAS No. 100-42-5, cinnamene, Diarex HF 77, ethenylbenzene, NCI-C02200, phenylethylene, styrol, styropor, vinylbenzene.

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

Cautions: Styrene is extremely flammable and polymerizes easily. The vapor is irritating to eyes, skin, and respiratory system and the liquid may cause burns. Inhalation of high concentrations can lead to central nervous system (CNS) depression.

R	2
I	3
S	2*
K	3

* Skin absorption

NFPA†

3
2 2
–

HMIS

H	2
F	3
R	2
PPG‡	

‡ Sec. 8

† Rating is for *inhibited* monomer

Section 2. Ingredients and Occupational Exposure Limits

Styrene *monomer*, ca 99.6%, containing inhibitors butylcatechol or hydroquinone

1991 OSHA PELs
8-hr TWA: 50 ppm (215 mg/m³)
15-min STEL: 100 ppm (425 mg/m³)

1990 IDLH Level
5000 ppm

1990 NIOSH RELs
TWA: 50 ppm (215 mg/m³)
STEL: 100 ppm (425 mg/m³)

1991-92 ACGIH TLVs (Skin)
TWA: 50 ppm (213 mg/m³)
STEL: 100 ppm (426 mg/m³)

1990 DFG (Germany) MAKs
Ceiling: 20 ppm (85 mg/m³)
Half-life: < 2 hr
Peak Exposure Limit: 40 ppm, 30 min. average value, 4 per shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 20 µg/m³ caused eye effects.
Human, skin: 500 mg (non-standard test, *accident*) caused irritation.
Human, HeLa cell: 28 mmol/L caused unscheduled DNA synthesis.
Rat, oral, LD_{50}: 5000 mg/kg; toxic effects not yet reviewed
Rat, inhalation, LC_{50}: 24 g/m³/ 4 hr produced an antipsychotic effect.

* See NIOSH, *RTECS* (WL3675000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 293 °F (145 °C)
Freezing Point: -23 °F (-31 °C)
Vapor Pressure: 5 mm Hg at 68 °F (20 °C)
Viscosity: 0.751 mPa
Refraction Index: 1.5463 at 68 °F (20 °C)
Odor Threshold Range: 0.15 to 25 ppm
Density: 0.9045 at 25/25 °C
Surface Tension: 32.14 dyne/cm at 66.2 °F (19 °C)
Molecular Weight: 104.2
Saturated Vapor Density (air = 1.2 kg/m³): 1.22 kg/m³ or 0.076 lbs/ft³
Water Solubility: Practically insoluble, 0.3 lbs/100 lbs water; floats on water
Other Solubilities: Soluble in benzene, carbon disulfide, carbon tetrachloride, ethanol, ethyl ether and ketones. Dissolves organic substances and polymers.

Appearance and Odor: Colorless to slightly yellow oily liquid with a sweet, pleasant odor at low levels becoming pungent as levels increase.

Section 4. Fire and Explosion Data

Flash Point: 88 °F (31 °C), CC	**Autoignition Temperature:** 914 °F (490 °C)	**LEL:** 1.1% v/v	**UEL:** 7% v/v

Extinguishing Media: A Class 1C flammable liquid. For small fires, use dry chemical, carbon dioxide (CO_2), or regular foam. For large fires, use fog, or regular foam. Water may be ineffective since styrene tends to float on water; use only when other agents are unavailable.

Unusual Fire or Explosion Hazards: Styrene may accumulate static electricity. Hazardous polymerization can occur causing container to rupture due to heat of fire. Vapors may travel to ignition source and flash back. Styrene 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. Structural firefighter's protective clothing provides only limited protection. Use protective clothing specifically recommended by manufacturer. Apply cooling water to container sides until well after fire is out. If possible without risk, remove container from fire area. Stay away from ends of tanks. For massive fire in cargo area use monitor nozzles or unmanned hose holders; if this is impossible, withdraw from area and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Uninhibited styrene monomer is very unstable and even when inhibited (butylcatechol or hydroquinone) polymerization occurs slowly at room temperature and fast at elevated temperatures or in contact with certain initiators. **Chemical Incompatibilities:** Styrene vapor is explosive when exposed to heat or flame; reacts with oxygen above 104 °F (40 °C) to form a heat-sensitive explosive peroxide. Violent polymerization may be initiated by alkali metal-graphite composites, butyllithium, dibenzoyl peroxide, azoisobutyronitrile or di-*tert*-butyl peroxide. Styrene reacts violently with chlorosulfonic acid, oleum, sulfuric acid, chlorine + iron (II) chloride (above 50 °C) and can react vigorously with oxidizing materials. **Conditions to Avoid:** Exposure to heat and ignition sources, light, and contact with incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of styrene can produce carbon dioxide, acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC[164] lists styrene monomer as a carcinogen; Class 2B (possibly carcinogenic, limited human evidence in the absence of sufficient animal data). **Summary of Risks:** Styrene is irritating to the eyes, skin, and respiratory system. It is absorbed through the skin at 9 to 15 mg/m²/hr (hand and forearm). Inhalation of high concentrations can cause CNS depression but styrene's pungent, irritating odor is usually enough to prevent acute toxic exposures. If heavy exposure occurs, styrene can saturate the body in 30-40 minutes, is distributed throughout the organs and is rapidly eliminated (~85% in 24 hr) either in urine (71%) or expired air (10%). Unexcreted styrene accumulates in adipose tissue (subcutaneous connective tissue containing fat cells). Ovulation and menstrual disorders were observed in women exposed to styrene. In one case, CNS effects were observed in infants whose mother was exposed to chemicals such as styrene during pregnancy. In general, pregnant women may be at elevated risk because styrene crosses the placental barrier. **Target Organs:** CNS, eyes, respiratory system, and skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Medical Conditions Aggravated by Long-term Exposure:** Possibly, liver, kidney, blood, skin, and CNS disorders.

Acute Effects: Inhalation of concentrations as low as 50 ppm causes irritation of the eyes, and respiratory tract.

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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

45

Xylene (Mixed Isomers) (C_8H_{10}) 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.

R 1
I 2
S 2
K 3

NFPA
3
2 0
–

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)

1990 IDLH Level
1000 ppm

1990 NIOSH RELs
TWA: 100 ppm (435 mg/m^3)
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

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

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.

* 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: *ortho:* 291 °F (144 °C); *meta:* 281.8 °F (138.8 °C); *para:* 281.3 °F (138.5 °C)
Freezing Point/Melting Point: *ortho:* -13 °F (-25 °C); *meta:* -53.3 °F (- 47.4 °C); *para:* 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

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 (CO_2), 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.

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Material Safety Data Sheets Collection:

Sheet No. 683
Polychlorinated Biphenyls (PCBs)

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

Section 1. Material Identification

39

Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] Description: A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

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

NFPA

HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kaneclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m^3)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift

TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m^3)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD_{Lo}: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m^3

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 °F (340-375 °C)
Melting Point: 42%: -2.2 °F (-19°C); 54%: 14 °F (-10 °C)
Vapor Pressure: 1 mm Hg at 100 °F (38 °C); 10^{-6} to 10^{-3} mm at 20 °C
Molecular Weight: 188.7 to 398.5
Specific Gravity: 1.3 to 1.8 at 20 °C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats, slightly soluble in glycerol and glycols.

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

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

Section 4. Fire and Explosion Data

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

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 °F (600-650 °C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

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Material Safety Data Sheet Collection

2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin (TCDD)

MSDS No. 906 Date of Preparation: 6/94

Section 1 - Chemical Product and Company Identification

44

Product/Chemical Name: 2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin (TCDD)
Chemical Formula: $C_{12}H_4Cl_4O_2$
CAS No.: 1746-01-6
Synonyms: dioxin; dioxine; NCI-C03714; tetrachlorodibenzodioxin; 2, 3, 7, 8-tetrachlorodibenzo(b, e)(1, 4)dioxin; 2, 3, 7, 8-tetrachlorodibenzo-1, 4-dioxin; TCDBD; TCDD; 2, 3, 7, 8-TCDD; tetradioxin
Derivation: TCDD is not manufactured, but is formed as a by-product of chlorobenzenes, chlorophenols, and the herbicides 2, 4, 5-trichlorophenoxyacetic acid (2, 4, 5-T) and 2-(2, 4, 5-trichlorophenoxy)propionic acid (Silvex) which are produced from 2, 4, 5-trichlorophenol (TCP). 2, 4, 5-T, commonly known as Agent Orange, was the defoliant used during the Vietnam War. TCP, 2, 4, 5-T and Silvex are no longer commercially produced in the U.S. As a chemical and toxicological standard, TCDD can be prepared by catalytic condensation of potassium 2, 4, 5-trichlorophenate. TCDD has been released to the environment during the incineration of chemical wastes including chlorinated benzenes, chlorophenols, and biphenyl ethers, from the improper disposal of certain chlorinated chemical wastes, in emissions from wood burning in the presence of chlorine, in accidental fires involving transformers containing PCBs, and from the use of the herbicides 2, 4, 5-T and Silvex.
General Use: TCDD is an extremely toxic, unwanted by-product and essentially has no beneficial uses. It may be used as a research chemical. **Vendors:** Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin, ca 100 %wt. TCDD normally persists as a contaminant in TCP in variable amounts (0.07-6.2 mg/kg). Consequently, the concentrations of TCDD in different batches of Agent Orange varied greatly with an average concentration of about 2 ppm.

OSHA PEL*
None established

ACGIH TLV
None established

NIOSH REL
Carcinogen, lowest feasible concentration.

DFG (Germany) MAK
None established

* A preliminary occupational exposure limit of 0.2 ng/m^3 (200 pg/m^3) is recommended. It provides an ample margin of safety to prevent chloracne and takes into consideration the chronic effects of animal studies and accidental human exposure. [Leung HW et al; *American Industrial Hygiene Association Journal*, 49 (9): 466-74 b(1988)]

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

TCDD is a colorless, crystalline solid at room temperature. It is highly toxic and a potential human carcinogen. Exposure to TCDD-contaminated materials may cause a severe and disabling acne-like rash that may persist for years (chloracne), metabolic disorders, and nervous system and liver damage. In animals, TCDD causes teratogenesis, tumorigenesis, and immunological dysfunction. Findings in humans are inconclusive, but human toxicology is under continuing investigation. Workers may be exposed to TCDD from residues from prior production or use of 2, 4, 5-T or Silvex, waste materials contaminated by TCDD, or contamination resulting from transformer fires. Take every precaution to avoid any exposure to TCDD.

Wilson Risk Scale	
R	1
I	4
S	4*
K	1

*Skin absorption

HMIS	
H	4†
F	1
R	0

†Chronic Effects
PPE‡
‡Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation (dust),* skin contact, ingestion.
Target Organs: Skin, liver, and nervous system.
Acute Effects
Inhalation: Shortness of breath, headaches, fatigue, severe muscle pains, weakness, and digestive disturbance. Most symptoms develop slowly, over many days.
Eye: Conjunctivitis and chemical burns.
Skin: Chemical burns. In most cases, chloracne appears within 2 to 4 weeks after initial exposure. It consists of blackheads with small, pale-yellow cysts. In severe cases, there may be papules (red spots) or even pustules (pus-filled spots). This acne-like rash appears on the cheekbones under the eyes and behind the ears in very mild cases. With increasing severity, the rest of the face and neck are affected and the outer upper arms, chest, back, abdomen, outer thighs and genitalia may be involved in varying degrees in the worst cases. In the worst cases, lesions may be active 15 or more years after the contact has ceased. Chloracne may also appear after ingestion or inhalation. Skin fragility, hirsutism (excessive growth of hair of normal or abnormal distribution), and photosensitivity may also occur.
Ingestion: Nausea, vomiting, and possible pancreatitis.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Administrative Controls: Consider preplacement and periodic medical examinations with emphasis on the skin, liver, nervous and endocrine systems. Regularly monitor glassware, bench tops, instruments, and tools with wipe tests (wipe with filter paper and measure amount of TCDD). **Respiratory Protection:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For situations where TCDD contamination is low (e.g., exposure to dust contaminated with low levels of TCDD), wear an air-purifying respirator until the extent and characterization of the exposure can be determined. For materials highly contaminated with TCDD, wear respirators that consist of self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive pressure mode. An alternate method utilizes a combination Type C supplied-air respirator, with full facepiece, operated in a pressure-demand mode and equipped with auxiliary positive pressure self-contained air supply. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Protective Clothing/Equipment:** Consider disposable clothing due to the uncertainty of adequate decontamination. Wear protective clothing consisting of both outer (zippered coverall with attached hood and draw string or elastic sleeves, gloves and closure boots) and inner (cotton overalls, undershirts, undershorts, gloves, and socks) garments. For dust or particulate exposure, wear coveralls of a non-woven fabric such as Tyvek or spun bonded polyethylene. For exposure to liquids, wear coveralls, gloves, and boots made of chemically resistant materials such as Saranax coated Tyvek or butyl, nitrile, or neoprene rubber. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area. **Contaminated Equipment:** Shower and change clothes after potential exposures or at the end of the work day. Separate contaminated work clothes from street clothes. Launder before reuse. Place disposable clothing in marked and approved containers for disposal. Remove this material from your shoes and clean personal protective equipment. To prevent cross-contact, provide segregated decontamination locations with separate, controlled, and well-marked entry/exit routes and locations. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: Colorless needles
Water Solubility: 19.3 ng/L
Other Solubilities: *o*-dichlorobenzene (1.4 g/L); chlorobenzene (0.72 g/L); benzene (0.57 g/L); chloroform (0.37 g/L); acetone (0.11 g/L); *n*-octanol (0.05 g/L); methanol (0.01 g/L); lard oil (0.04 g/L)

Vapor Pressure: 7.4×10^{-10} mm Hg at 77 °F (25 °C)
Formula Weight: 322
Melting Point: 581-583 °F (305-306 °C)
Octanol/Water Partition Coefficient: log Kow= 7.02
Henry's Law Constant: 1.62×10^{-5} atm m^3/mole at 25 °C (estimated)

Section 10 - Stability and Reactivity

Stability: TCDD is relatively stable toward heat, acids, and alkalis. It is changed chemically when exposed in isooctane or *n*-octanol to UV light. **Polymerization:** Hazardous polymerization cannot occur. **Chemical Incompatibilities:** None reported. **Conditions to Avoid:** Avoid heat and ignition sources. **Hazardous Decomposition Products:** Thermal oxidative decomposition of TCDD can produce toxic fumes of chlorine. Decomposition begins at 932 °F (500 °C) and complete decomposition occurs within 21 sec at 1472 °F (800 °C).

Section 11- Toxicological Information

Toxicity Data:*

Eye Effects:
Rabbit, eye: 2 mg caused moderate irritation.
Acute Effects:
Human, skin, TD_{Lo}: 107 µg/kg produced dermatitis and allergic reaction.
Mammal, oral, LD_{50}: 4200 ng/kg produced changes of the liver, kidney, ureter, bladder, and spleen.
Rat, oral, LD_{50}: 20 µg/kg
Reproductive Effects:
Monkey, oral, TD_{Lo}: 92 ng/kg (46 weeks prior to mating, on each day during gestation, and for 17 weeks following birth) caused effects on the newborn (behavioral; delayed effects).
Genetic Effects:
Human cell: 100 pmol/L caused unscheduled DNA synthesis.

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Material Safety Data Sheets Collection:
Sheet No. 317
Toluene
Issued: 8/79 Revision: E, 9/92 Errata: 2/94

Section 1. Material Identification

Toluene ($C_6H_5CH_3$) Description: Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.

Other Designations: CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.

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

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

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

NFPA

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

Section 2. Ingredients and Occupational Exposure Limits

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

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

1990 IDLH Level
2000 ppm

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

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

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

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, LD_{Lo}: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, LD_{50}: 5000 mg/kg
Rat, liver: 30 µmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
†See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)
Melting Point: -139 °F (-95 °C)
Molecular Weight: 92.15
Density: 0.866 at 68 °F (20/4 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Viscosity: 0.59 cP at 68 °F (20 °C)
Refraction Index: 1.4967 at 20 °C/D
Water Solubility: Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0797 lb/ft^3 or 1.2755 kg/m^3
Odor Threshold (range of all referenced values): 0.021 to 69 ppm

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

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC	**Autoignition Temperature:** 896 °F (480 °C)	**LEL:** 1.27% v/v	**UEL:** 7.0% v/v

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

Section 5. Reactivity Data

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

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm^2/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next pa

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Material Safety Data Sheets Collection:

Sheet No. 7
Nitric Acid

Issued: 10/88 Revision: D, 9/92

Section 1. Material Identification

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Nitric Acid (HNO_3) Description: A solution of nitrogen dioxide in water commercially available in many concentrations. Derived by oxidation of ammonia by catalytic process (heated platinum catalyst); or by direct synthesis, combining atmospheric nitrogen and oxygen in an electric arc (an expensive process, thus largely abandoned). HNO_3 is usually found in conjunction with nitrogen dioxide, which is considered more hazardous. Used in fertilizer production (ammonium nitrate), in photoengraving, steel etching, explosives (TNT, nitroglycerin, trinitrophenol); manufacture of metallic nitrates, sulfuric acid, aqua regia and oxalic acid, jewelry, various dyes and dyestuffs, pharmaceuticals; as a laboratory reagent, in metallurgy (*mainly* as a pickling agent) and the printing industy.
Other Designations: CAS No. 7697-37-2, aqua fortis, aqua regia, azotic acid, engravers nitrate, hydrogen nitrate, red fuming nitric acid (RFNA), white fuming nitric acid (WFNA).
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for suppliers list.

Cautions: Nitric acid is a corrosive, strong oxidizer that causes irritation or severe burns to the skin, eyes, and respiratory tract. Exposures to high levels of the concentrated acid can be fatal. Increases the flammability of combustibles. Use extreme caution when handling HNO_3.

		HMIS		NFPA
R 2 I 4 S 4 K 0	H 3* F 0 R 1 PPE**	*Fuming* nitric acid		0 3 1 ox
R 2 I 4 S 4 K 0	H 3* F 0 R 1 PPE**	*> 40%* nitric acid		0 3 0 ox
R 2 I 3 S 3 K 0	H 3* F 0 R 0 PPE**	*≤ 40%* nitric acid		0 3 0 –

* Chronic effects ** See Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Nitric acid, various %. Commercially available in nearly all concentrations; most common are 56 and 68%. RFNA (85%), WFNA (97.5%).

1991 OSHA PELs
8-hr TWA: 2 ppm (5 mg/m^3)
15-min STEL: 4 ppm (10 mg/m^3)

1990 IDLH Level
100 ppm

1990 NIOSH REL
8-hr TWA: 2 ppm (5 mg/m^3)
15-min STEL: 4 ppm (10 mg/m^3)

1992-93 ACGIH TLVs
TWA: 2 ppm (5.2 mg/m^3)
STEL: 4 ppm (10 mg/m^3)

1990 DFG (Germany) MAK
2 ppm (5 mg/m^3)
Category I: local irritants
Peak Exposure Limit: 2 ppm
5 min momentary value, 8 per shift

1985-86 Toxicity Data*
Man, unreported route, LD_{Lo}: 110 mg/kg; toxic effects not yet reviewed
Rat, oral, TD_{Lo}: 5275 g/kg administered from 1 to 21 days of pregnancy caused post-implantation mortality and specific developmental abnormalities of the musculoskeletal system.
Rat, inhalation, LC_{50}: 67 ppm (NO_2)/4 hr; toxic effects not yet reviewed

* See NIOSH, *RTECS* [QU5775000 (nitric acid), QU5900000 (RFNA), QU6000000 (WFNA)], for additional reproductive and toxicity data.

Section 3. Physical Data

Boiling Point: 186.8 °F (86 °C)
Melting Point: -43.6 °F (-42 °C)
Vapor Pressure: 67% HNO_3 = 6.8 mm Hg at 68 °F (20 °C); 95 to 98% = 113 at 100.4 °F (38 °C)
Saturated Vapor Density (Air = 1.2 kg/m³): 1.212 kg/m^3 or 0.0757 lb/ft^3 (67 % HNO_3)
pH: 1
Molecular Weight: 63.02
Density: 1.50269 at 77/39.2 °F (25/4 °C)
Water Solubility: Soluble (releases heat)
Ionization Potential: 11.95 eV

Appearance and Odor: Transparent, clear to yellow, fuming liquid with an acrid, suffocating odor which darkens to a brownish color on aging and exposure to light. "Fuming" nitric acid is red-brown in color.

Section 4. Fire and Explosion Data

Flash Point: Noncombustible	**Autoignition Temperature:** Noncombustible	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: For small fires (< 40% HNO_3), use dry chemical, carbon dioxide (CO_2), water spray, or regular foam. For large fires, use water spray, fog, or regular foam. For small fires (> 40% HNO_3), use water spray, dry chemical, or soda ash. For large fires, flood area with water (*do not* get inside HNO_3 containers). Apply water from as far a distance as possible.
Unusual Fire or Explosion Hazards: HNO_3 is noncombustible but is an oxidizer which increases fire involving combustibles and can initiate an explosion. It releases flammable hydrogen gas in contact with many metals.
Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is not effective for fires involving nitric acid. Acid-resistant clothing is needed. Apply cooling water to sides of containers 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. *Do not* release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Nitric acid decomposes in air and in contact with light and organic matter. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Nitric acid reacts explosively with combustibles, organics or readily oxidizable materials such as wood, turpentine, metal powder and hydrogen sulfide, carbides, cyanides, and alkalies; causes spattering with strong bases; is corrosive to paper, cloth and most metals (except aluminum, gold, platinum, thorium, and tantalum. Will also attack some forms of plastics, rubber, and coatings. There are at least 150 chemicals and chemical combinations which are incompatible with nitric acid. HNO_3 reacts with water to produce heat and toxic corrosive fumes. Refer to *Genium* references 126 and 159 for further detail. **Conditions to Avoid:** Avoid exposure to moisture, heat, and incompatibles.
Hazardous Decomposition Products: Thermal oxidative decomposition of HNO_3 produces nitrogen peroxide and toxic, irritating nitrogen oxides.

Section 6. Health Hazards Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list nitric acid as a carcinogen.
Summary of Risks: Nitric acid is very corrosive to the skin, eyes, digestive and respiratory tract or any tissue it comes in contact with. 58 to 68% (nitric acid) vapors are moderately irritating and can't be tolerated at high concentrations. 95% (nitric acid) vapors cause severe irritation at very low levels and the liquid causes 2nd and 3rd degree burns on short contact with skin or eyes. Vapor inhalation may cause pulmonary edema (fluid in lungs) leading to death. HNO_3 vapor or mist can slowly corrode teeth when chronically exposed. **Medical Conditions Aggravated by Long-Term Exposure:** Chronic respiratory diseases. **Target Organs:** Eyes, skin, respiratory tract, teeth.

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Material Safety Data Sheet Collection

Coal Tar Creosote **MSDS No. 757**

Date of Preparation: 7/91 Revision: A, 9/97

Section 1 - Chemical Product and Company Identification 50

Product/Chemical Name: Coal tar creosote

Chemical Formula: Not found; consists of many compounds and the composition depends on the coal used to make the tar and the design and operating conditions of the coke oven and still.

CAS Number: 8001-58-9

Synonyms: AWPA #1; brick oil; Caswell No. 225; coal tar oil; creosote; creosote oil; creosote P1; creosotum; cresylic creosote; heavy oil; liquid pitch oil; naphthalene oil; Preserv-o-sote; Sakresote; tar oil; wash oil

Derivation: By distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking.

General Use: Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, tap hole refractory cement, and lubricant for die molds. Used only in limited quantities as an animal and bird repellent, animal dip, and insecticide (ovicide).

Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Coal tar creosote consists of aromatic hydrocarbons, anthracene, naphthalene, and phenanthrene derivatives; some tar acids; and tar bases. Polycylic aromatic hydrocarbons make up at least 75%.* (198)

OSHA PEL†
8-hr TWA: 0.2 mg/m^3

ACGIH TLV†
TWA: 0.2 mg/m^3

NIOSH REL†
0.1 mg/m^3 (cyclohexane-extractable fraction)
Carcinogen

IDLH Level†
80 mg/m^3

DFG (Germany) MAK
None established

* Creosote contains several carcinogenic polycyclic aromatic hydrocarbons including benz[a]anthracene, benzo[a]pyrene, and dibenz[a,h]anthracene.

† Coal tar pitch volatiles, as benzene solubles (CAS No. 65996-93-20)

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Coal tar creosote is a colorless (pure) or yellow to black (industrial) liquid with an aromatic smoky smell. It is irritating to the eyes, skin and respiratory tract and can be corrosive, causing severe burns. Coal tar creosote is a probable human carcinogen. It is a combustible liquid that is a moderate fire hazard when exposed to an ignition source.

Wilson Risk Scale
R 1
I 3
S 3
K 2
* Skin absorption

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

Potential Health Effects

Primary Entry Routes: Inhalation, skin absorption, and skin and/or eye contact

Target Organs: Eyes, skin, bladder, kidneys, and respiratory system

Acute Effects *Note! Phenol and phenolic derivatives of various aromatic hydrocarbons (tar acids), present in low concentrations, are the constituents most likely to be responsible for acute toxicity.*

Inhalation: Inhalation of vapors causes moderate irritation to the nose, throat, and upper respiratory tract.

Eye: Contact with liquid causes conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. May cause loss of vision.

Skin: Contact causes irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur.

Ingestion: Causes salivation, nausea; vomiting; gastrointestinal tract irritation or bleeding; abdominal pain; rapid, thready pulse; vertigo; headaches; loss of pupillary reflexes; hypothermia; cyanosis; respiratory distress; shock and mild convulsions. Large doses may be fatal.

Carcinogenicity: IARC classifies coal tar creosote as Group 2A: probably carcinogenic to humans: limited human evidence, sufficient animal evidence. NTP classifies coal tar creosote as Group 2B: sufficient evidence of carcinogenicity from studies in experimental animals. OSHA does not specifically classify coal tar creosote as a carcinogen. NIOSH classifies coal tar pitch volatiles, as benzene solubles, as a carcinogen defined with no further categorization.

Medical Conditions Aggravated by Long-Term Exposure: Skin disorders.

Chronic Effects: Include dermatitis and, possibly, skin cancer or other forms of cancer. An increased risk of scrotal cancer for creosote-exposed brick makers was indicated in a worker mortality analysis. Epidemiological studies of coke oven workers reveal increased incidences of lung, bladder, prostate, pancreas, and intestinal cancer.

Ventilation: Provide general or local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.$^{(103)}$

Administrative Controls: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney disorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the attending physician considers appropriate. Educate workers about the health and safety hazards associated with coal tar creosote.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. (The following respirator recommendations are for coal tar pitch volatiles.) For concentrations above the NIOSH REL or at any detectable concentrations, wear a SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent any skin contact. With breakthrough times of >8 hr, butyl rubber, Teflon™, and Viton™ are recommended materials. Frequent change of protective garments is an additional protective measure. Wear protective eyeglasses or chemical safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses.

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

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

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

Section 9 - Physical and Chemical Properties

Physical State: Oily liquid

Appearance and Odor: Colorless (pure) or yellow to black (industrial); aromatic smoky smell

Specific Gravity (H_2O=1, at 4 °C): 1.07 to 1.08 at 68 °F (20 °C)

Water Solubility: Slightly soluble

Other Solubilities: Soluble in alcohol; ether; glycerin; dimethyl sulfate; fixed or volatile oils; in solution of fixed alkali hydroxides.

Boiling Point Range: 381 to 752 °F (194 to 400 °C)

Octanol/Water Partition Coefficient: $\log K_{ow} = 1.0$

Heat of Combustion: -12,500 Btu/lb; -6,900 cal/g

Section 10 - Stability and Reactivity

Stability: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.

Conditions to Avoid: Avoid excessive heat and contact with chlorosulfonic acid.

Hazardous Decomposition Products: Thermal oxidative decomposition of coal tar creosote can produce carbon oxides and thick, black, acrid smoke.

Section 11 - Toxicological Information

Toxicity Data:*

Genetic Effects:

S. typhimurium: 20 µg/plate (-S9) produced mutations.

Hamster, ovary cell: 10 mg/L induced sister chromatid exchange.

Reproductive Effects:

Mouse, oral: 2 g/kg administered on gestational days 5-9 produced maternal effects and fetotoxicity.

Acute Oral Effects:

Rat, oral, LD_{50}: 725 mg/kg

Mouse, oral, LD_{50}: 433 mg/kg

Tumorigenicity: Mouse, skin, 99 g/kg/33 weeks administered intermittently produced tumors on skin and appendages (carcinogenic by RTECS criteria).

* See NIOSH, *RTECS* (GF8615000), for additional toxicity data.

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Material Safety Data Sheets Collection:

Sheet No. 789
Cyanide

Issued: 11/91

Section 1. Material Identification

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Cyanide (CN^-) Description: Derived by combining a carbon ion with a nitride ion. Used in rat and pest poisons, silver and metal polishes, photographic solutions, fumigating products, and electroplating solutions. Cyanide may also be liberated in burning of plastics, natural fabrics (wool or silk), polyurethane bedding or furniture, acrylic baths, nylon carpets, and melamine resin insulation.

Other Designations: CAS No. 57-12-5, carbon nitride ion, cyanide anion, isocyanide.

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

Cautions: Cyanide is severely toxic by all routes of entry and its lethal dose is an estimated 1 µg/ml. Take necessary precautions to avoid all possible exposure to this material.

R	1
I	4
S	2
K	1

Genium

HMIS

H	4
F	1
R	1
PPG*	

* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Cyanide, ca 100%

1990 OSHA PEL (Skin)
STEL: 4.7 ppm, 5 mg/m³, as hydrogen cyanide (gas)

1990 IDLH Level
50 mg/m³

1991-92 ACGIH TLV (Skin)
Ceiling: 10 ppm, 11 mg/m³, as hydrogen cyanide (gas)

1990 NIOSH REL (Skin)
STEL: 4.7 ppm, 5 mg/m³ as hydrogen cyanide (gas)

1990 DFG (Germany) MAK (*Danger of cutaneous absorption*)
TWA: 10 ppm, 11mg/m³ as hydrogen cyanide (gas)

1985-86 Toxicity Data*
Mouse, intraperitoneal, LD_{50}: 3 mg/kg; toxic effects not yet reviewed

* See NIOSH, *RTECS* (GS7175000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Varies with specific CN^- compound
Melting Point: Varies with specific CN^- compound
Molecular Weight: 26.02
Density: Varies with specific CN^- compound
Water Solubility: Varies with specific CN^- compound

Appearance and Odor: Varies with specific CN^- compound, but usually has an almond odor.

Section 4. Fire and Explosion Data

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

Extinguishing Media: Cyanide is combustible. For small fires, use dry chemical, water spray or foam. *Do not use carbon dioxide* (*CO_2*)*!* For large fires, use water spray, fog, or regular foam. *Do not scatter* material with more water than needed to extinguish fire.

Unusual Fire or Explosion Hazards: Combustible by chemical reaction with heat, moisture, or acid. Many cyanides readily evolve hydrogen cyanide (HCN), a toxic flammable gas.

Special Fire-fighting Procedures: Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing *is ineffective* for fires involving cyanide. Wear chemical protective clothing that the shipper or manufacturer specifically recommends. If possible without risk, remove container from fire area. Fight fire from maximum distance. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Remove and isolate contaminated clothing at the site.

Section 5. Reactivity Data

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

Chemical Incompatibilities: Cyanide may react violently with hypochlorite solutions at pH 10 to 10.3, is explosive with nitrites if heated above 450 °C, and is incompatible with chlorates, fluorine, magnesium, nitrates, and all inorganic acids.

Conditions to Avoid: Avoid exposure to heat and contact with incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition of cyanide can produce carbon dioxide and toxic, flammable vapors of CN^-.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list cyanide as a carcinogen.

Summary of Risks: Cyanide is a potent, fast-acting, chemical asphyxiant (material which causes pulse and breathing obstruction) that prevents tissue utilization of oxygen by inhibiting the enzyme involved (cytochrome oxidase). Death can occur within seconds to minutes after inhalation of some cyanide gases, and may take as long as an hour after ingestion of a large amount of a cyanide salt due to a slower absorption. Toxicity is dependent on the form of cyanide the victim is exposed to. Mortality from acute exposures is high, but recovery is generally complete in nonfatal cases.

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

Continue next page

MATERIAL SAFETY DATA SHEET: CRYSTAL SIMPLE GREEN®

I. PRODUCT & COMPANY INFORMATION

PRODUCT NAME: **CRYSTAL SIMPLE GREEN®**

OTHER NAMES: **CRYSTAL SIMPLE GREEN® - SPECIALIZED CLEANER / DEGREASER**
SIMPLE GREEN SAFETY TOWELS (fluid only)

COMPANY NAME: **SUNSHINE MAKERS, INC.**
15922 Pacific Coast Highway
Huntington Harbour, CA 92649 USA
Telephone: 800-228-0709 • 562-795-6000
Fax: 562-592-3034
Website: www.simplegreen.com

Version No. 4006
Issue Date: January 2002

For 24-hour emergency, call Chem-Tel, Inc.: 800-255-3924

USE OF PRODUCT: A specialized cleaner and degreaser for use in the industrial and institutional workplace..

II. INGREDIENT INFORMATION

The only ingredient of Crystal Simple Green® with established exposure limits is undiluted 2-butoxyethanol (<6%) (Butyl Cellosolve; CAS No. 111-76-2): the OSHA PEL and ACGIH TLV is 25 ppm (skin). Note, however, that Butyl Cellosolve is only one of the raw material ingredients that undergo processing and dilution during the manufacture of Crystal Simple Green®. Upon completion of the manufacturing process, Crystal Simple Green® does not possess the occupational health risks associated with exposure to undiluted Butyl Cellosolve. Verification of this is contained in the independent test results detailed under "Toxicological Information" on Page 3 of this MSDS.

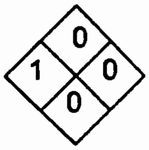
The Butyl Cellosolve in Crystal Simple Green® is part of a chemical category (glycol ethers) regulated by the Emergency Planning and Community Right-to-Know Act (SARA, Title III, section 313); therefore, a reporting requirement exists. Based upon chemical analysis, Crystal Simple Green® contains no known EPA priority pollutants, heavy metals, or chemicals listed under RCRA, CERCLA, or CWA. Analysis by TCLP (Toxicity Characteristic Leaching Procedure) according to RCRA revealed no toxic organic or inorganic constituents.

All components of Crystal Simple Green® are listed on the TSCA Chemical Substance Inventory.

III. HAZARDS IDENTIFICATION

UN Number: Not required
Dangerous Goods Class: Nonhazardous

Hazard Rating (NFPA/HMIS)
Health = 1* Reactivity = 0
Fire = 0 Special = 0



Rating Scale
0 = minimal 1 = slight
2 = moderate 3 = serious
4 = severe

*Mild eye irritant, non-mutagenic and non-carcinogenic. **None of the ingredients in Crystal Simple Green® are regulated or listed as potential cancer agents by Federal OSHA, NTP, or IARC.**

IX. PERSONAL PROTECTION

Precautionary Measures: No special requirements under normal use conditions.
Eye Protection: Caution, including reasonable eye protection, should always be used to avoid eye contact where splashing may occur.
Skin Protection: No special precautions required; rinse completely from skin after contact.
Respiratory Protection: No special precautions required except during large-scale spray applications where spray mist levels are high.
Work and Hygienic Practices: Wash or rinse hands before touching eyes or contact lenses. Follow standard hygienic practices for handling cleaning agents.

X. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/odor::	Clear liquid	Vapor Pressure:	18 mm Hg @ 20 °C; 23.5 mm Hg @ 26 °C
Specific Gravity:	1.020	Vapor Density:	1.3 (air = 1)
pH of concentrate:	9.35	Density:	8.5 lbs./gallon
Evaporation:	>1 (butyl acetate = 1)		
Boiling Point:	100.6 °C (212 °F)		
Freezing Point:	-9 °C (16 °F) If product freezes, it will reconstitute without loss of efficacy when brought back to room temperature and agitated.		

VOC Composite Partial Pressure: 0 mm Hg @ 20 °C
Volatile Organic Compounds (VOCs): 0 g/L per ASTM Method D-2369. Per California AQMD's VOC test method, product must be diluted at least 2 parts of water to 1 part Crystal Simple Green® in order to meet SCAQMD Rule 1171 & Rule 1122 and BAAQMD Regulation 8-16 VOC requirements for solvent cleaning operations.
Water Solubility: Completely soluble in water.
Detection: Crystal Simple Green® has a characteristic odor that is not indicative of any hazardous situation.

XI. STABILITY AND REACTIVITY INFORMATION

Nonreactive. Crystal Simple Green® is stable, even under fire conditions, and will not react with water or oxidizers. Hazardous polymerization will not occur.

XII. TOXICOLOGICAL INFORMATION

The information and conclusions cited in this section are based on data and testing of Simple Green®. The data are directly applicable to Crystal Simple Green® because, except for the fragrance and dyes which have been removed, it contains the same ingredients as Simple Green®.

Nonhuman Toxicity

Acute Mortality Studies:
Oral LD_{50} (rat): >5.0 g/kg body weight // Dermal LD_{50} (rabbit): >2.0 g/kg body weight

Dermal Irritation: Only mild, but reversible, irritation was found in a standard 72-hr test on rabbits. A value of 0.2 (non-irritating) was found on a scale of 8.

Eye Irritation: With or without rinsing with water, the irritation scores in rabbits at 24 hours did not exceed 15 (mild irritant)
on a scale of 110.

Subchronic dermal effects: No adverse effects, except reversible dermal irritation, were found in rabbits exposed to Simple Green® (up to 2.0 g/kg/day for 13 weeks) applied to the skin of 25 males and 25 females. Only female body weight gain was affected. Detailed microscopic examination of all major tissues showed no adverse changes.

Fertility Assessment by Continuous Breeding: The Simple Green® formulation had no adverse effect on fertility and reproduction in CD-1 mice with continuous administration for 18 weeks, and had no adverse effect on the reproductive performance of their offspring.

Appendix C

Sample Medical Data Form

MEDICAL DATA FORM

Fill in the following information:

Name: ____

Address: ____

____

Home Phone: ____________________ Age: ________ Height:______

Weight: ____________

Name of person to be notified in case of emergency:

____

All prescription and nonprescription medications currently being used:

____

Allergies: ____

Particular sensitiveness: ____

Use of contact lenses or eyeglasses: ____

Short medical history including list of previous illnesses and any prior exposure to chemicals:

____

____

____

Name and telephone number of personal physician:

____

Appendix D

Accident Report Form

ACCIDENT REPORT FORM

Report No. ________

Site: ______________________________ Project No. ______________

Location: ____

Date of Report: ________________ Preparer's Name: ____________________

Name and Address of Injured: ____________________ SSN: - - Age: _____

____ Sex: _____

Years of Service: _______ Time on Present Job: _______ Title/Classification: ______________

Division/Department ________________ Date of Accident ________ Time: ________

Accident Category: ___ Motor Vehicle ___ Property Damage ___ Fire

___ Chemical Exposure ___ Near Miss ___ Other

Severity of Injury or Illness: ____ Non-disabling ___ Disabling

____ Medical Treatment ___ Fatality

Amount of Damage: $______________ Property Damaged: ______________

Estimated Number of Days Away from Job: ______________________

Nature of Injury or Illness: ______________________________

CLASSIFICATION OF INJURY:

- ____ Fractures
- ____ Dislocations
- ____ Sprains
- ____ Abrasions
- ____ Lacerations
- ____ Punctures
- ____ Bites
- ____ Toxic Ingestions
- ____ Heat Burns
- ____ Chemical Burns
- ____ Radiation Burns
- ____ Bruises
- ____ Blisters
- ____ Toxic Respiratory Exposure
- ____ Toxic Ingestions
- ____ Dermal Allergy
- ____ Cold Exposure
- ____ Frostbite
- ____ Heat Stroke
- ____ Heat Exhaustion
- ____ Concussion
- ____ Faint/Dizziness
- ____ Toxic Respiratory

ACCIDENT REPORT FORM
(continued)

Part of Body Affected: ______________________________

Degree of Disability: ______________________________

Date Medical Care Was Received: ______________________________

Where Medical Care Was Received: ______________________________

Address (if off site): ____________

ACCIDENT LOCATION:

Causative agent most directly related to accident (object substance, material, machinery, equipment conditions):

____

____

Was weather a factor? ______________________________

Unsafe mechanical/physical/environmental condition at time of accident (be specific):

____

____

Unsafe act by injured and/or others contributing to the accident (be specific, must be answered):

____

Personal factors (improper attitude, lack of knowledge or skill, slow reaction, fatigue):

____

____

ACCIDENT REPORT FORM
(continued)

Level of personal protection equipment required in Site Safety Plan: ______________________________

____

Modifications: ____

Was injured using required equipment? ______________________________________

If not, how did actual equipment use differ from plan? ______________________________

____

What can be done to prevent a recurrence of this type of accident (modification of machine; mechanical guards; correct environment training):

____

____

Detailed narrative description (how did accident occur, why; objects, equipment, tools used, circumstance assigned duties) (be specific):

____

____

(Use separate sheet as required)

Witnesses to accident ____

Signature of Preparer ____

Signature of Site Leader ____

Appendix E

OSHA Form 300

OSHA Form 300 (Effective 1/1/04)

OSHA's Form 300
Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year ______

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an injury and illness incident report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name ______________________

City ______________________ State ______________________

Identify the person		Describe the case				Classify the case										
(A) Case No.	(B) Employee's Name	(C) Job Title (e.g., Welder)	(D) Date of injury or onset of illness (mo./day)	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	Using these categories, check ONLY the most serious result for each case:				Enter the number of days the injured or ill worker was:		Check the "injury" column or choose one type of illness:				
						Death	Days away from work	Remained at work		On job transfer or restriction (days)	Away from work (days)	(M)				
								Job transfer or restriction	Other record-able cases			Injury	Skin Disorder	Respiratory Condition	Poisoning	All other illnesses
						(G)	(H)	(I)	(J)	(K)	(L)	(1)	(2)	(3)	(4)	(5)
					Page totals	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Injury	Skin Disorder	Respiratory Condition	Poisoning	All other illnesses
(1)	(2)	(3)	(4)	(5)

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name ______________________

City ______________________ State __________

Identify the person			Describe the case			Classify the case CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "Injury" column or choose one type of illness: (M)					
								Remained at Work									
(A) Case no.	(B) Employee's name	(C) Job title (*e.g., Welder*)	(D) Date of injury or onset of illness	(E) Where the event occurred (*e.g., Loading dock north end*)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (*e.g., Second degree burns on right forearm from acetylene torch*)	Death (G)	Days away from work (H)	Job transfer or restriction (I)	Other record-able cases (J)	Away from work (K)	On job transfer or restriction (L)	Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
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____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
					Page totals➤	____	____	____	____	____	____	____	____	____	____	____	____
												Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

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Appendix F

Employer's First Report of Injury Form

STANDARD FORM FOR
EMPLOYER'S FIRST REPORT OF INJURY

Employer

1. Name of Employer ____________________
2. Office address: No. & St.____________City/town ____________________State____
3. Insured by Name of Company ____________________
4. Give nature of business (or article manufactured) ____________________

Time and Place

5. (a) Location of plant or place where accident occurred ____________________
   (b) If injured in a mine, did accident occur on surface, underground, shaft, drift or mill
   ____________________.
6. Date of injury __________20___ Day of week _____ Hour of day ____________a.m. _____p.m.______
7. Date disability began __________20___ a.m.____ p.m.______
8. Was injured paid in full for this day ____________________
9. When did you or foreman first know of injury ____________________
10. Name of foreman ____________________

Injured Person

11. Name of Injured ____________________
    (First Name) (Middle Initial) (Last Name) (SS#)
12. Address: No. and St.____________________ City/Town ____________________State __
13. Check (✓) Married____ Single____ Widowed____ Widower____ Divorced____ Male ____ Female____
14. Age _____ Did you have on file employment certificate or permit ____________________
15. (a) Occupation when injured________________
    (b) Was this his or her registered occupation ____________________
    (If not, state in what department or branch of work regularly employed ____________________
16. (a) How long employed by your ________ (b) Wages per day $________________
17. (a) No. hours worked per day ________ (b) Wages per day $________________
    (c) No. days worked per week ________ (d) Average weekly earnings $________________
    (e) If board, lodging, fuel or other advantages were furnished in addition to wages, give estimated value per day, week or month ____________________

Cause of Injury

18. Machine, tool or thing causing injury ____________________
19. Kind of power (hand, foot, electrical, steam, etc.) ____________________
20. Part of machine on which accident occurred ____________________
21. (a) Was safety appliance or regulation provided ________
    (b) Was it in use at time ____________________
22. Was accident caused by injured's failure to use or observe safety appliance or regulation ____________________
23. Describe fully how accident occurred, and state what employee was doing when injured
    ____
    ____
    ____
24. Names and addresses of witnesses ____________________
    ____

Nature of Injury

25. Nature and location of injury (describe fully exact location of ____________________
    amputations or fractures, right or left)____________________
    ____
26. Probable length of disability ____________________
27. Has injured returned to work ____________________ If so, date and hour ____________________
    At what wage $____________
28. At what occupation ____________________
29. (a) Name and address of physician ____________________
    (b) Name and address of hospital ____________________

Cases Fatal

30. Has injured died ____________________ If so, give date of death ____________________

Date of this report ____________________ Firm name ____________________

Signed by ____________________

Official Title ____________________

Appendix G

Record of Safety Meetings

RECORD OF SAFETY MEETINGS

Date/Time	Location	Attended By	Company	Affiliation

Appendix H

Community Air Monitoring Plan

Community Air Monitoring Plan
Glen Cove
Former Manufactured Gas Plant Site

In accordance with NYSDEC and NYSDOH requirements for a Community Air Monitoring Plan (CAMP), a perimeter air-monitoring plan, will be implemented at the site during each phase of the field activities. The objective of the perimeter air-monitoring plan is to provide a measure of protection for the downwind community (i.e., off-site receptors, including residences and businesses and on-site workers not involved with the site field activities) from potential airborne contaminant releases as a direct result of field activities. The perimeter air-monitoring plan is a stand-alone document and will be available on site. The VOC Monitoring, Response Levels, and Actions are presented as follows.

Air Monitoring Response Levels and Actions

Response Level	Actions
	VOCs
>5 ppm above background for 15-minute average	▪ Temporarily halt work activities ▪ Continue monitoring ▪ If VOC levels decrease (per instantaneous readings) below 5 ppm over background, work activities can resume
Persistent levels >5 ppm over background <25 ppm	▪ Halt work activities ▪ Identify source of vapors ▪ Corrective action to abate emissions ▪ Continue monitoring ▪ Resume work activities if VOC levels 200 feet downwind of the property boundary or half the distance to the nearest potential receptor is <5 ppm for a 15-minute average ▪ If VOC levels are >25 ppm at the perimeter of the work area, activities must be shutdown
	Particulate
>100 mcg/m3 above background for 15-minute average or visual dust observed leaving the site	▪ Apply dust suppression ▪ Continue monitoring ▪ Continue work if downwind PM-10 particulate levels are <150 mcg/m3 above upwind levels and no visual dust leaving site
>150 mcg/m3 above background for 15-minute average	▪ Stop work ▪ Re-evaluate activities ▪ Continue monitoring ▪ Continue work if downwind PM-10 particulate levels are <150 mcg/m3 above upwind levels and no visual dust leaving site

Sources:

New York State Department of Health Community Air Monitoring Plan, June 20, 2000.

New York State Department of Environmental Conservation Division Technical and Administrative Guidance Memorandum - Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites, October 27, 1989.

During excavating and materials handling operations, the air in work areas will also be sampled periodically for the presence of contaminants. A portable photoionization detector (PID) will be utilized to periodically monitor the levels of organic vapors in the ambient air and a Mini RAM$^{\text{TM}}$ PM-10 (or equivalent) particle detector will be used to count inhalable particles (0.1-10 micrometer range) of dust during the field work. PID and Mini RAM readings will be taken hourly during excavation or more frequently if air quality measurements approach action levels as defined herein. Measurements will be monitored from the breathing zone (4 to 5 feet above ground level) at worker locations to determine working conditions (and whether there is a need to change levels of worker protection).

In addition to VOCs and particulates, cyanide will be monitored in the work zone and at the perimeter of the work area. The cyanide monitoring methods will be determined prior to mobilization, but at a minimum, will include Drager® tube sampling.

In order to make a conservative assessment of when different levels of respiratory protection are needed during the field work, it will be assumed that the organic vapors detected by the air monitoring instruments consist of the most toxic volatile compounds expected to be found on the site. Preliminary evaluation of the risks expected at the site indicates that the most toxic volatiles that are probably present are VOCs (particularly BTEX). Based on data published by the Occupational Safety and Health Administration (OSHA) and the American Conference of Government Industrial Hygienists (ACGIH), and GEI's experience with MGP wastes, the following PPE will be employed when the given concentrations of organic vapor are detected in the breathing zone.

Compound of Concern	**Level D**	**Level C**	**Level B**
Chemical Name	M<X	X<M<Y	M>Y
BTEX and other photoionizable VOCs	M <5 ppm	5 ppm <M <50 ppm	M >50 ppm

Where: M = concentration of organic vapor measured in the field
X,Y= concentrations at which different levels of respiratory protection are necessary.

The PPE requirements may be modified based on compound-specific monitoring results information, with the written approval of the Corporate Health and Safety Specialist (CHSS).

Respiratory protection from dusts will be required when inhalable particulate concentrations from potentially contaminated sources exceed 150 µg/m$^{3.}$

Odors or dusts derived from site contaminants may cause nausea in some site workers, even though the contaminants are at levels well below the safety limits as defined above. Workers may use dust masks or respirators to mitigate nuisance odors with the approval of the SSO.

Whenever practical, work areas should be positioned upwind of organic vapor and dust sources to reduce the potential for worker exposure.