UCRL-21172 Rev. 2

Environmental Protection Department
Environmental Restoration Program and Division

Site Safety Plan for Lawrence Livermore National Laboratory CERCLA Investigations at Site 300

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FOR INFORMATION ONLY

August 1997

Lawrence Livermore National Laboratory
University of California Livermore, California 94551

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Site Safety Plan
for
LLNL CERCLA Investigations
at Site 300

Review and Concurrence:

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Site 300 Resident Manager — Date

9-19-97

John Kilmer
Site 300 Restoration Project Site Safety Officer — Date

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John Ziagos — 9/19/97

John Ziagos
Site 300 Restoration Project Leader — Date

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Foreward

Various Department of Energy Orders incorporate by reference, health and safety regulations promulgated by the Occupational Safety and Health Administration (OSHA). One of the OSHA regulations, 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*, requires that site safety plans are written for activities such as those covered by work plans for Site 300 environmental investigations.

Based upon available data, this Site Safety Plan (Plan) for environmental restoration has been prepared specifically for the Lawrence Livermore National Laboratory Site 300, located approximately 15 miles east of Livermore, California. As additional facts, monitoring data, or analytical data on hazards are provided, this Plan may need to be modified. It is the responsibility of the Environmental Restoration Program and Division (ERD) Site Safety Officer (SSO), with the assistance of Hazards Control, to evaluate data which may impact health and safety during these activities and to modify the Plan as appropriate. This Plan is not "cast-in-concrete." The SSO shall have the authority, with the concurrence of Hazards Control, to institute any change to maintain health and safety protection for workers at Site 300.

1. Emergency Contacts

This may be updated as necessary to reflect current personnel, telephone numbers, positions and any other outdated information.

Local Contacts for All Emergencies

From Lawrence Livermore National Laboratory (Site 300) phones	***911***
Offsite Emergency Response	**(510) 447-6880**

Hazardous Materials Information

Toxline	(301) 496-1131
CHEMTREC (24-hour, emergency only)	(800) 424-9300
ORNL, Toxicology Information Response Center	(615) 576-1743

Data Access

Current safety documents and reference materials can be located in the Environmental Restoration Program and Division (ERD) Office.

LLNL Contacts

John Ziagos, ERD Site 300 Project Leader	(510) 422-5479
John Kilmer, ERD Site 300 Site Safety Officer (SSO)	(510) 423-3445
Beeper	(510) 423-7705-00921
Greg Santucci, ERD Site 300 SSO–Backup	(510) 423-5043
Beeper	(510) 423-7705-06502
Jerry Bardecker–ES&H Team 1 Deputy Division Leader	(510) 423-6150

Site 300 Organizational Structure

Figure 1 is a general organizational chart for the Environmental Restoration Program and Division Site 300 Project.

Standard Procedures for Reporting Emergencies

When calling **911** for assistance in an emergency situation, the following information should be provided:

1. Name of person making call.
2. Telephone number and location of person making call.

3. Name of person(s) exposed or injured and location.
4. Nature of emergency and type of exposure, when appropriate.
5. Actions already taken.

Never hang up first when calling for emergency assistance. Wait for the dispatch operator to finish all questions.

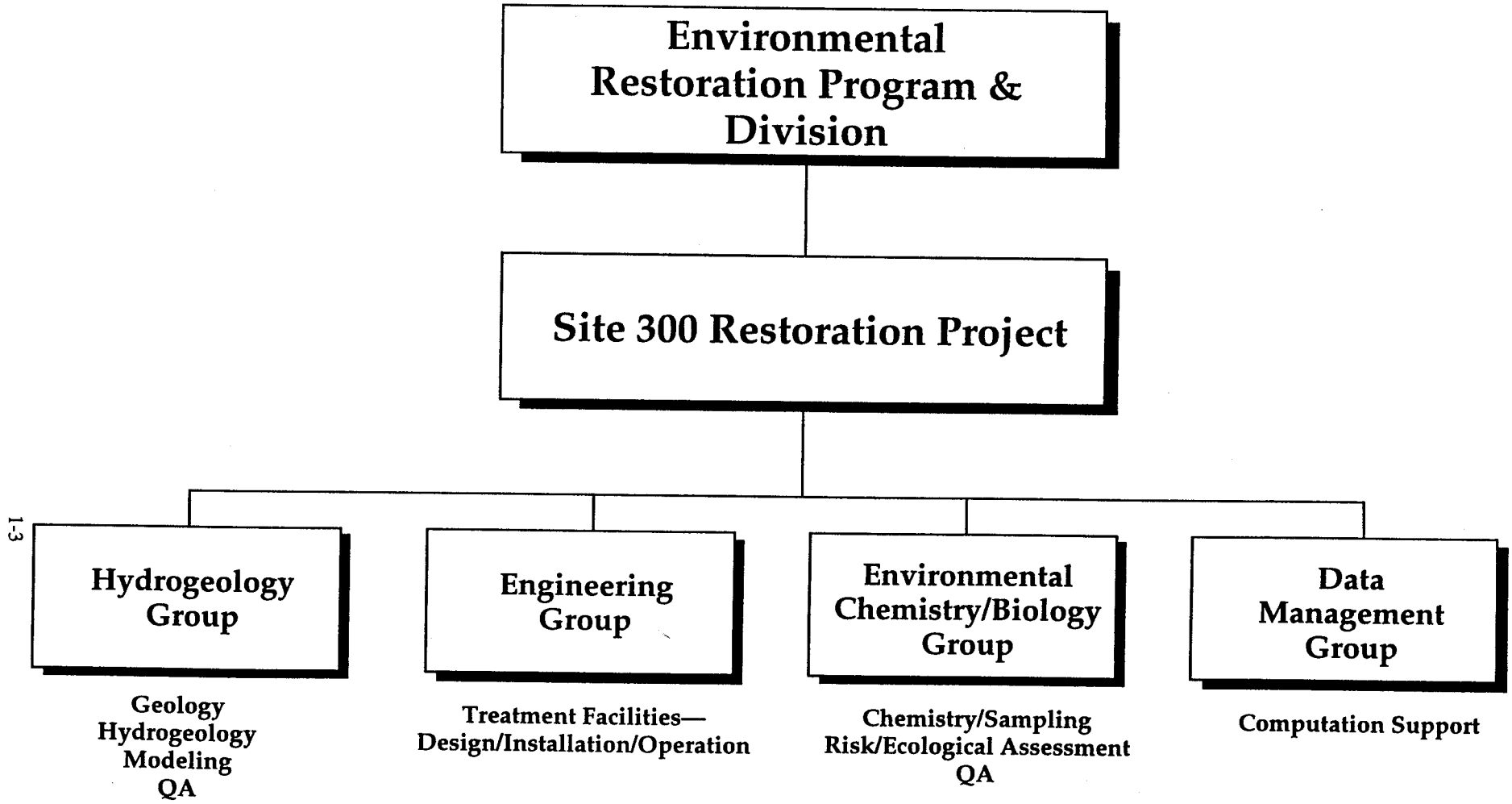


Figure. 1. Site 300 Restoration Program and Division organizational chart.

2. General Information and Policies

The safety policy of LLNL is to take every reasonable precaution in the performance of work to protect the environment and the health and safety of employees and the public, and to prevent property damage. With respect to hazardous agents, this protection is provided by limiting human exposures, releases to the environment, and contamination of property to levels that are as low as reasonably achievable. It is the intent of this Site Safety Plan (SSP) to supply the broad guidance to ERD employees and subcontractors for completing environmental investigations. It may not be possible to determine actual working conditions in advance of the work; therefore, planning must allow the opportunity to provide a range of protection based upon actual working conditions. Requirements will be the least restrictive possible for a given set of circumstances, such that work can be completed in a safe, efficient, and timely fashion.

Due to the relatively large size of Site 300 and the different types of activities underway, site-specific Operational Safety Procedures (OSPs) and Standard Operating Procedures (SOPs) may be prepared to supplement activities not covered by this SSP or the LLNL Health and Safety Manual. These site-specific OSPs provide the detailed information for each specific activity and act as an addendum to this SSP, which provides the general plan for ERD Site 300 operations.

ERD employees and subcontractors working at LLNL must follow the policies set forth in this SSP, as well as LLNL and the U.S. Department of Energy (DOE) policies, procedures, and instructions. Of special value are the *LLNL Health and Safety Manual* (Hazards Control Department, M-010) and support provided by the LLNL Hazards Control Safety Teams. Subcontractors must have their own health and safety procedures and training, which address operations that fall under the respective subcontracts, which may be modeled after those provided by LLNL. These procedures must be reviewed and approved by the SSO, or a designee, prior to the initiation of work.

Each time the term SSO is used, either the SSO or a designee should take responsibility or complete the action.

Employees are obligated to halt work and bring to the attention of their supervisor any unsafe or hazardous condition that they observe as they carry out their responsibilities. The supervisor shall inform the SSO promptly so that the situation can be corrected and personnel can be advised of an improved procedure. It is impossible to anticipate all specific safety and health hazards beforehand; therefore, all personnel must exercise common sense and good judgment in their approach to a given situation.

The Health and Safety Training described in Section 9 of this document will assist in preparing individuals to recognize hazards. All personnel potentially exposed to physical or chemical hazards as described in this SSP shall follow the safety and health procedures set forth herein.

Any modifications to this SSP will be issued as attachments to this document.

3. Summary of Background Information

LLNL operates the Site 300 Experimental Test Site in support of the DOE Stockpile Stewardship and Management Program and other non-defense programs. The principal activity of the site is to perform tests on the high explosives component of stockpile weapons systems. Site 300 is located in the eastern Altamont Hills about 15 miles southeast of LLNL and 65 miles southeast of San Francisco.

The DOE is required to maintain an environmental protection program and has implemented the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) through DOE Order 5480.14. The responsibility for conducting environmental restoration of Site 300 is vested in the LLNL Site 300 Restoration Project, which is part of LLNL's Environmental Protection Department, Environmental Restoration Program and Division. Regulatory oversight is provided by the U.S. Environmental Protection Agency (EPA), the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board-Central Valley Region (RWQCB-CV).

Since 1982, LLNL has conducted a series of investigations to identify areas of soil, rock, and ground water contamination. The goal has been to remediate those areas to bring Site 300 into compliance with Federal, State, and local regulations. Seven operable units have been designated at Site 300 which correspond to areas containing ground water contamination (Fig. 2). An eighth operable unit has also been designated to cover areas still requiring investigation or require ongoing monitoring. In addition, the Site 300 Restoration Project is responsible for closing the high-explosives burn pit under the Resource Conservation and Recovery Act (RCRA).

Analytical results from various sampling activities and quarterly ground water monitoring have identified the presence of various contaminants. Volatile organic compounds (VOCs) have been found at varying concentrations in the parts-per-billion (ppb or µg/L) range, with trichloroethylene levels approaching parts-per-million (ppm or mg/L) concentrations. Tritium in ground water has been found at activities of up to 1,300,000 picocuries per liter (pCi/L) and 16,000,000 pCi/L in soil moisture. HE compounds have been identified at concentrations of up to 350 ppb (µg/L) in ground water and 18 ppm (mg/kg) in soil. Depleted uranium in soil has been found at activities of up to 141 pCi/gram (g). Lead and beryllium have been detected at very low ppm (mg/L) concentrations in ground water.

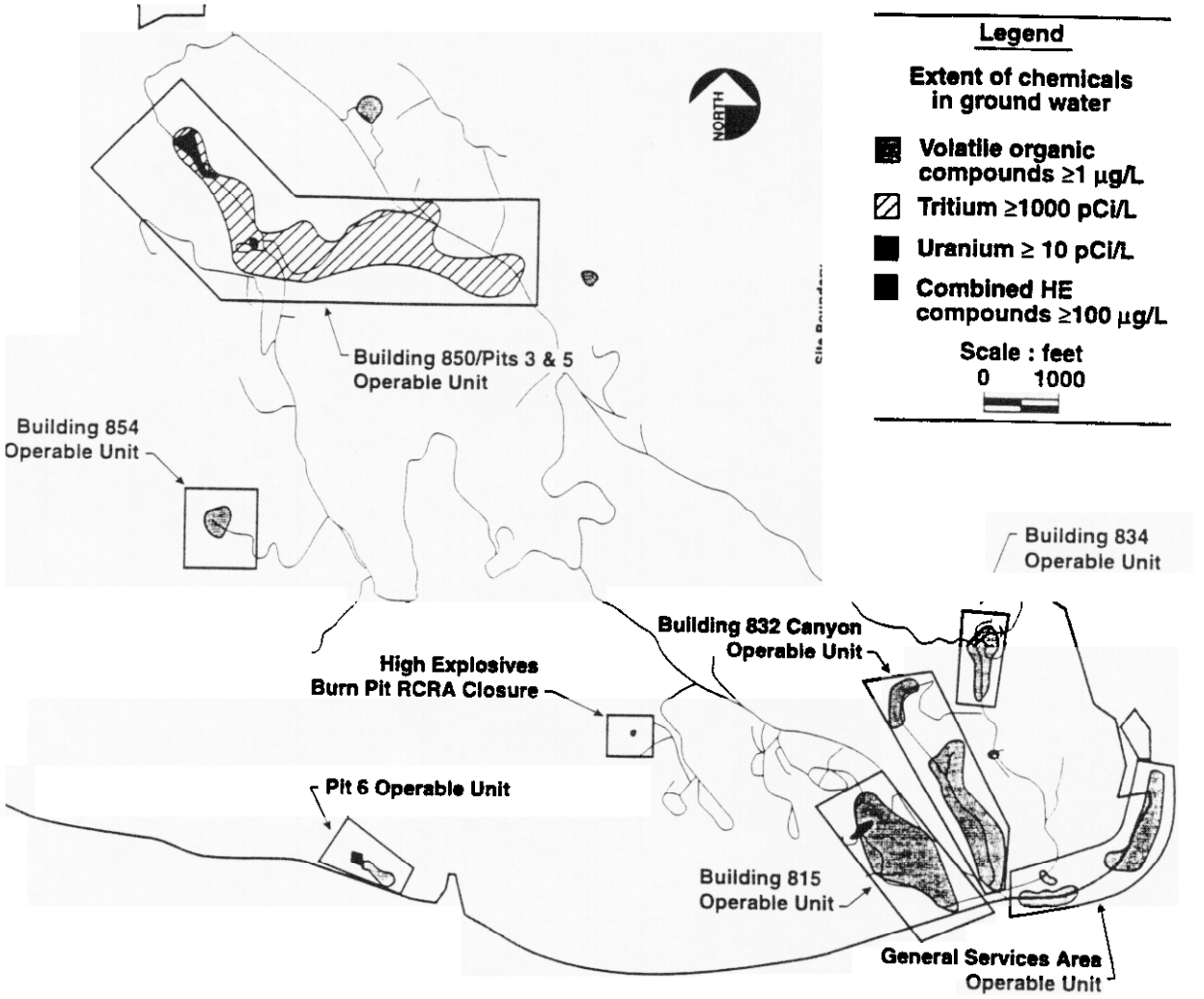
On the basis of analytical results, the substances present in environmental media at Site 300 include:

- Trichloroethylene (TCE), Tetrachloroethylene (PCE), and other related VOCs
- Beryllium.
- Lead and other metals.
- Natural and depleted uranium.
- HMX [octahydro-1,3,5,7-tetranitro-tetrazocine].
- RDX [hexahydro-1,3,5-trinitro-1,3,5-triazine.
- Tritium.
- Diesel and gasoline hydrocarbons.

Other work activities may pose potential exposures or problems due to:

- Fuel Hydrocarbons:
  - Benzene
  - Gasoline
  - Toluene
  - Xylene
- Heavy equipment
- Noise
- Nuisance dust
- Snake bite
- Temperature extremes:
  - Heat stress
  - Cold exposure
- Unknown materials previously disposed of in landfills
- Valley Fever

This plan addresses health and safety issues related to the various tasks and phases for the environmental work planned and ongoing at Site 300. Technical issues and specifications for scope of work are presented in the specific LLNL quality assurance, work, and closure plans. These should be reviewed by the ERD SSO and Hazards Control ES&H Team 1 in conjunction with performing their responsibilities and to assist in presenting pertinent health and safety concerns to site workers.



ERD-S3R-97-0159

Figure 2. Environmental restoration activities and the extent of ground water contamination at LLNL Site 300.

4. Organization, Responsibilities, and Authority

4.1. Organization

Key ERD personnel are listed below by name, title, address, and telephone number.

Albert L. Lamarre
LLNL ERD Division Leader
L-544, P.O. Box 808
Lawrence Livermore National Laboratory
Livermore, CA 94551
(510) 422-0757

John P. Ziagos
LLNL Site 300 Project Leader
L-544, P.O. Box 808
Lawrence Livermore National Laboratory
Livermore, CA 94551
(510) 422-5479

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LLNL Site 300 Restoration Project SSO
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Lawrence Livermore National Laboratory
Livermore, CA 94551
(510) 423-3445

The ERD Leader has ultimate authority over the overall operations of the site. He approves changes in the scope of the operations, schedules, etc.

The Site 300 Project Leader has ultimate authority over the overall operation of the site in the absence of the ERD Leader. He also has the responsibility to ensure that all operations are conducted by the SSO in accordance with this SSP.

Health and safety activities are important during all phases of any project. The degree of implementation of the activities or services is related to the perceived risk. The SSO shall have the responsibility to determine health and safety needs for this project and the authority to ensure that appropriate measures are taken. All ERD personnel shall comply with the requirements of this SSP and cooperate with project management in its implementation. It is the responsibility of all site personnel to immediately report any of the following to the SSO:

A. All accidents or injuries.

B. Unsafe or malfunctioning equipment.

C. Any symptoms or signs of chemical exposure.

D. Unexpected or uncontrolled releases of potentially hazardous materials.

E. Unauthorized personnel entry onto the site.

F. Any changes in the site conditions which might adversely affect the health and safety of personnel.

4.2. Responsibilities

4.2.1. Site Safety Officer (SSO)

The ERD SSO is responsible for:

a. Interfacing with ERD personnel to promote safety awareness and safe working practices.

b. Determining health and safety needs for the work site and implementing the safety controls contained in the applicable plans and procedures.

c. Ensuring that work areas are kept clean and orderly to control potential general safety hazards and that personnel adhere to established procedures.

d. Requiring specific health and safety precautions prior to work site entry by ERD and subcontract personnel, such as safety orientations.

e. Ensuring that proper personnel protective (PPE) equipment are available and worn by personnel, and that PPE and other equipment are maintained and properly stored.

f. Monitoring ERD and subcontractor operations for the existence of hazardous conditions, and monitoring personnel for signs of exposure, heat stress, fatigue, etc. and ordering the immediate evacuations from any work site when conditions posing an unacceptable risk arise through the course of work.

g. Evaluate results of the monitoring program and determine its impact on future operations.

h. Informing the Project Leader and Hazards Control Department of any health and safety conditions that may adversely affect the project.

i. Assuring that all required safety training is completed and documented.

j. Knowing LLNL's emergency procedures and contacts.

k. Ensuring that environmental and personnel monitoring operations are ongoing and carried out in accordance with technical specifications, procedures, and project instructions.

l. Implementing the DOE Explosives Safety Manual Waiver 97-12 with the Ground Water Sampling Coordinator. A copy of the waiver is attached in Appendix G.

The SSO shall immediately inform the Site 300 Project Leader of any health and safety conditions that may adversely affect the project.

The SSO, or designee, has the authority to:

- Obtain information and assistance from the Hazards Control Department or other appropriate support as warranted.
- Require specific health and safety precautions prior to work site entry by ERD and subcontract personnel, and ensure that personnel adhere to requirements of this SSP.

- Require any ERD or subcontract employee to obtain immediate medical attention in case of an injury or illness.
- Deny ERD and/or subcontract personnel access to any ERD work site.
- Establish an area where personnel are to gather if there is an evacuation from the work zone.
- Order the immediate evacuation of ERD and/or subcontract employees from any work site when hazardous conditions arise in the course of work.
- Permit visitors (i.e., anyone other than an ERD or subcontract employee) at work sites only at the direction of, and with the permission of, responsible ERD personnel.
- Monitor site conditions during operations to determine whether any changes in work zones or personnel protection are required.
- Ensure that work areas are kept clean and orderly to control potential general safety hazards.

The SSO will review and update this SSP every three years or as necessary to ensure that the SSP still reflects current ERD operations and organizational structure. The review will reflect changes in technology, operation, contamination, etc. The SSO or designee will also conduct work site safety briefings to cover the contents of this SSP, relevant OSPs, safe work practices, PPE use, and emergency procedures.

All ERD and subcontract personnel assigned to this project are responsible for following this SSP, using safe work practices, and wearing the PPE specified by the SSO. The SSO or designee shall inform all subcontractors of emergency response procedures and known hazards of the operations prior to site entry. Project personnel shall report hazards and unsafe conditions and practices to their supervisor and the SSO. Project personnel must comply with all Federal, State, and local health and safety regulations, as well as the LLNL Health and Safety Manual.

The ES&H Team 1 Division Leader (Hazards Control Department) provides an interface between the members of Hazards Control and ERD. The health and safety professionals and technicians assigned to ERD provide support and technical services to the SSO or designee as requested and required by LLNL policy.

4.2.2. Environmental Safety and Health (ES&H) Coordinator

The ERD ES&H Coordinator is responsible for:

a. Coordination of ES&H activities within ERD.

b Providing guidance to ERD personnel in meeting ES&H and DOE Conduct of Operations requirements.

c Maintaining direct communication and liaison with the EPD Quality Assurance (QA) Office and Division Leader for the implementation of ES&H requirements within ERD.

d. ES&H document preparation and review such as Operational Safety Procedures (OSPs), Operations and Maintenance (O&M) manuals.

e. Maintaining ERD's Deficiency Tracking system (DefTrack).

f. Planning and scheduling of ES&H walkthroughs, assessments, reviews, and surveillances of ERD facilities by external agencies (i.e., DOE and regulators) and internal teams (i.e., Hazard Control, Plant Operations Directorate, and EPD).

g. Conducting audits and assessments of ERD's compliance with ES&H requirements.

h. Assisting with the implementation of corrective actions to ES&H deficiencies.

i. Reviewing and critiquing draft DOE orders (i.e., occurrence reporting, facility maintenance programs), and LLNL's implementation of these Orders.

j. Tracking the application and expiration dates of treatment facilities permits, such as air and water discharge permits.

4.2.3. Quality Assurance (QA) Implementation Coordinator

The ERD QA Implementation Coordinator is responsible for:

a. Coordination of QA program implementation activities within ERD.

b. Providing guidance to ERD personnel in meeting QA Program requirements.

c. Maintaining direct communication and liaison with the EPD QA Office and Division Leader for the implementation of the QA Program within ERD.

d. QA document preparations such as, Project Quality Assurance Project Plan (QAPPs) and Annual QA Reports to ERD management.

e. Tracking and maintaining controlled documents and distribution lists.

f. Ensuring Standard Operating Procedures (SOPs) are developed to direct ERD activities.

g. Reviewing and concurring to all procedures for activities affecting quality to ensure conformance to EPD Quality Assurance Management Plan (QAMP) requirements.

h. Tracking Quality Improvement Forms (QIFs) that document corrective action for conditions adverse to quality to closure.

I. Maintaining database tracking system for all assessment, audits, and inspections.

j. Perform/oversee self-assessments of ERD activities and developing self-assessment schedules.

k. Continually working to improve ERD processes.

5. Medical Screening Program

The purpose of the medical screening program is to assess the health status of personnel prior to work, monitor personnel for evidence of post-project adverse health effects, and determine the suitability of individuals for future work assignments of this type. All personnel who will be working on this project must undergo a medical evaluation before participating in these operations. If the SSO determines that significant exposure to hazardous materials is encountered in these operations, a follow-up medical exam shall be conducted on the exposed individuals.

Baseline and periodic health assessments for project personnel shall be consistent with LLNL requirements and OSHA regulations prescribed in 29 CFR 1910, especially those in 1910.120, *Hazardous Waste Operations and Emergency Response.*

At a minimum, the examination should include:

- Medical and organizational histories.
- Physical examination.
- Vision test.
- Urinalysis.
- Blood chemistry panel and complete blood count.
- Pulmonary function tests and respirator use clearance.

Optional tests include:

- X-rays.
- Electrocardiograms.
- Bioassays for specific compounds, if recommended by the examining physician due to previous or expected exposures.
- Hearing Conservation Program.

Due to the low risk of acute exposure, additional medical monitoring specific to this project is not anticipated.

If an individual has completed an occupational medical exam within the past 12 months, the *examining physician* may determine that another complete exam is unnecessary.

In addition to the medical screening program, a medical surveillance program will be provided by ERD for its employees when one or more of the following items are applicable:

A. All employees who are or may be exposed to airborne levels of hazardous substances above OSHA Permissible Exposure Limits (PEL) or, in the absence of PEL, other published exposure limits, without regard to the use of respirators, for 30 days or more per year.

B. All those who use a respirator for 30 or more days per year or are required to do so under 29 CFR 1910.134 Respiratory Protection.

C. All employees who are injured due to overexposure from an emergency incident involving hazardous substances or health hazards.

Employees covered by the medical surveillance program will be given medical examinations and consultations at the following frequency:

A. Prior to assignment.

B. Annually unless attending physician extends the interval up to 2 years or decreases the interval as medically necessary.

C. At termination of employment or reassignment to another area where employee will not be under medical surveillance if the employee has not had an examination within the last 6 months.

D. As soon as possible after development of signs or symptoms indicating overexposure to hazardous substances above PEL or other published exposure levels in an emergency situation.

Medical examinations will include a medical and work history (or updated history if one is in the employee's file) with special emphasis on: symptoms related to the handling of hazardous substances, health hazards of these substances, and fitness for duty, including the ability to wear any required PPE under the conditions (i.e., temperature extremes) that may be expected at the work site. All medical examinations and procedures shall be performed by or under the supervision of a licensed physician.

The attending physician will be provided with the following information by the SSO or supervisor in conjunction with Hazards Control:

A. A description of the employee's duties as they relate to employee's exposures.

B. The employee's exposure levels or anticipated exposure levels.

C. A description of any personal protective equipment used or to be used. If respirators are to be worn, then information will be provided concerning the type, anticipated periods of use, workloads, etc., as required by 29 CFR 1910.134.

D. Where feasible, information from previous medical examinations of the employee that is not readily available to the examining physician.

E. A copy of this SSP and its appendices.

LLNL Health Services will provide each covered employee with a written opinion from the attending physician containing the following:

A. A summary of the results of the examination.

B. An opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of impairment of the employee's health from work in hazardous waste site operations or from the use of respirators. The written opinion shall not reveal specific findings or diagnoses unrelated to occupational exposure.

C. Any recommended limitations upon the employee's assigned work.

D. Any medical conditions which require further medical examination or treatment.

An accurate record of the medical surveillance required by this standard shall be retained in accordance with 29 CFR 1910.20. The record shall include at least the following items:

A. Employee's name and social security number.

B. Physician's written opinion, recommended limitations, and results of examinations and tests.

C. Any employee medical complaints related to exposure to hazardous substances.

D. A copy of the information provided to the examining physician by the employer with the exception of the standard and its appendices.

Employees who may be exposed to chemical hazards while performing project work must receive medical screening. LLNL will screen at-risk LLNL employees, and contract firms will screen their at-risk employees, as specified in their contracts with LLNL and DOE.

6. Hazard Evaluation

There are potential hazards associated with the environmental investigations of the LLNL Site 300. These include:

Chemical Hazards

- Benzene.
- Beryllium.
- Diesel.
- Gasoline.
- HMX.
- Hydrochloric acid.
- Lead.
- Nitric acid.
- RDX.
- Tetrachloroethylene.
- Trichloroethylene.
- Toluene.
- Tritium.
- Natural uranium.
- Depleted uranium.
- Xylene.

Biological Hazards

- Snake bite.
- Valley Fever.

Physical Hazards

- Heavy equipment (drill rigs, air compressors, backhoe, crane).
- Excavations.
- Overhead power lines.
- Underground utilities.
- Confined space entry.
- Fire and explosion.
- Electrical hazards.
- Noise.
- Heat stress.
- Frostbite and hypothermia.

General Safety Hazards

Hazards to Non-Project Personnel

6.1. Chemical Hazards

The chemicals or substances listed above as chemical hazards may enter the body through inhalation, skin absorption, or ingestion. These chemicals may enter by more than one route, may cause damage at the point of entry, or may cause organ damage after being metabolized.

The operations on some sites may involve the use of hazardous substances used in the operations or stored onsite. For example, hydrogen peroxide (50%), which is a strong oxidizer, may be used at some sites to treat ground water contamination.

The SSO and/or site supervisor will ensure that all site employees are trained in accordance with 29 CFR 1910.1200, Hazard Communication and the LLNL *Health and Safety Manual* Supplement 7.02 (formerly 1.02).

Exposure limits, detectable limits, and other references to airborne chemical concentrations given below are for vapors or particulates in air. Concentrations encountered in soil and ground water are generally several orders of magnitude lower than the limits specified here. Therefore, even direct contact with soil and ground water and exposure to associated contaminants is unlikely to produce acute exposures.

The respiratory hazards associated with work activities are exposure to vapors, gases, and/or particulates such as dusts during drilling, well installation, tank excavation, decontamination, and other operations. It is not anticipated that exposure levels in excess of recommended permissible exposure limits (PELs) or threshold limit values (TLVs) will be encountered. However, precautions must be taken to minimize dust generation during work activities that contain toxic compounds such as lead or beryllium. This may require spraying the work area with water in sufficient amounts to control dust. The open-air environment at the site should provide adequate ventilation to reduce potential respiratory hazards to very low or negligible levels. Dermal hazards result from direct contact of solids, liquids, or vapors with the skin. Since the potential for vapor contact is low, dermal hazards from vapors are expected to be negligible. Direct contact with contaminated soil and ground water in the field would not generally result in dermal effects. Acids used for sample preservation are corrosive to the skin, eyes, and respiratory tract. Therefore, good hygienic practices, and the fact that these chemicals may be absorbed through the skin or are corrosive, warrant protecting the skin.

Based upon previous experience at this site, it is anticipated that direct skin contact is unlikely to occur if protective clothing and/or protective equipment is used as specified in Section 8.

To prevent ingestion of hazardous or toxic materials, workers should wash their hands prior to eating, drinking, smoking, or using restroom facilities.

Abbreviations and acronyms relating to exposure limits are provided in Appendix A. Readily available Material Safety Data Sheets (MSDSs) are provided in Appendix B. All MSDSs are available through the LLNL internal home page Grapevine under ES&H Resources.

6.1.1. Benzene

Odor: Aromatic; odor threshold, approximately 4.7 ppm.

Fire Potential: Dangerous; when exposed to heat or flame can react vigorously with oxidizing materials.

Flammable Limits—LFL 1.3%, UFL 7.9%.
Explosive Limits—LEL 1.3%, UEL 7.1%.

Exposure: Irritating to eyes, nose, and throat. Suspected human carcinogen. Symptoms: dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction, loss of consciousness.

OSHA PEL: TWA, 1 ppm; STEL, 5 ppm.

ACGIH TLV*: TWA, 10 ppm; IDLH, 2,000 ppm.

6.1.2. Beryllium

Fire Potential: Combustible; poisonous gases may be produced in fire.

Exposure: Dust is extremely toxic when inhaled. Symptoms: coughing, shortness of breath, acute or chronic lung disease. Any dramatic, unexplained weight loss should be considered as first indication of beryllium disease.

OSHA PEL: TWA, 2 $\mu g/m^3$; Ceiling, 5 $\mu g/m^3$; Max. peak, 25 $\mu g/m^3$ for 30 min.

ACGIH TLV: TWA, 2 $\mu g/m^3$; suspect human carcinogen.

Note: DOE is considering lowering PEL for beryllium to 1.0 $\mu g/m^3$.

6.1.3. Diesel

Odor: Characteristic of petroleum distillate.

Fire Potential: Flash point 185°C; fire hazard greater if liquid temperature exceeds 85°F; may explode if pressure is used to empty drums.

Exposure: Irritating to eyes, nose, and throat; central nervous system depressant if inhaled. Symptoms: headache, dizziness, loss of appetite, weakness, and loss of coordination. Incomplete combustion produces carbon monoxide; toxic fumes may accumulate.

ACGIH TLV: Not established. Reduce exposure to lowest feasible level.

6.1.4. Gasoline

Odor: Characteristic of gasoline; odor threshold, 0.25 ppm.

Fire Potential: Flammable; flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

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* TLV may be reduced to 0.1 ppm.

Flammable Limits—LFL 1.4%, UFL 7.4%.

Exposure: Irritating to eyes, nose, and throat. Symptoms: irritation of mucous membranes, dizziness, headache, incoordination, anesthesia, coma.

ACGIH TLV: TWA, 300 ppm; STEL, 500 ppm.

6.1.5. HMX (*Synonym:* Octogen)

Fire Potential: Moderate, by spontaneous chemical reaction.

Exposure: Irritation of eyes and respiratory tract.

DOT-Hazard: Cannot be shipped in a dry state.

6.1.6. Hydrochloric Acid

Odor: Pungent; sharp.

Fire Potential: Not flammable. Flammable hydrogen gas may be formed on contact with metals.

Exposure: Irritating to eyes, nose, and throat. Severe skin irritant.

OSHA PEL: Ceiling, 5 ppm for 15 min.

ACGIH TLV*: Ceiling, 5 ppm.

IDLH: 100 ppm.

6.1.7. Lead

Exposure: Lead is a potent, systemic poison. Chronic exposure may result in damage to blood-forming, nervous, urinary, and reproductive systems.

OSHA PEL: TWA, 50 $\mu g/m^3$.

ACGIH TLV: TWA, 0.15 mg/m^3.

6.1.8. Nitric Acid

Odor: Acrid; sweet to acrid.

Fire Potential: Not flammable; may cause fire on contact with combustibles. Flammable hydrogen gas may be formed on contact with metals.

Exposure: Corrosive to tissue, may cause severe burns to eyes and skin. Irritating to eyes, nose, and throat. May also release toxic oxides of nitrogen (NO_x) gas.

OSHA PEL: TWA, 2 ppm; STEL, 4 ppm.

ACGIH TLV: TWA, 2 ppm; STEL, 4 ppm.

IDLH: 100 ppm.

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* TLV may be reduced to 50 $\mu g/m^3$.

6.1.9. RDX (*Synonym:* Cyclonite)

Fire Potential: Moderate, by spontaneous chemical reaction.

Exposure: Irritation of eyes and respiratory tract. May be absorbed through intact human skin.

ACGIH TLV: TWA, 1.5 mg/m^3.

6.1.10. Tetrachloroethylene (PCE)

Odor: Ether-like; odor threshold, 5 ppm.

Fire Potential: Nonflammable.

Exposure: Irritating to eyes, nose, and throat. Symptoms: affects central nervous system, causes anesthesia and peripheral neuropathy. Potent liver toxin. This compound may be carcinogenic.

OSHA PEL: TWA, 100 ppm; ceiling, 200 ppm; max. peak, 300 ppm; 5 minutes in any 3 hours.

ACGIH TLV: TWA, 50 ppm; STEL, 200 ppm.

IDLH: 500 ppm.

6.1.11. Trichloroethylene (TCE)

Odor: Sweet; odor threshold, 50 ppm.

Fire Potential: Low fire hazard.

Flammable Limits—LFL 8%, UFL 10.5%.
Explosive Limits—LEL 12.5%, UEL 90%.

Exposure: Irritating to eyes, nose, and throat. Symptoms: nausea, blurred vision, disturbance of central nervous system. Liver toxin. This compound may be carcinogenic.

OSHA PEL: TWA, 100 ppm; ceiling, 200 ppm; max. peak, 300 ppm; 5 min. in any 2 hours.

ACGIH TLV: TWA, 50 ppm; STEL, 200 ppm.

IDLH: 1,000 ppm.

6.1.12. Toluene

Odor: Sweet, pungent, benzene-like odor; odor threshold, 0.17 to 2.1 ppm.

Fire Potential: Flammable liquid ignitable under almost all normal temperature conditions.

Flammable Limits—LFL 1.2%, UFL 7.1%.
Explosive Limits—LEL 1.2%, UEL 7.1%.

Exposure: Irritating to eyes, nose, throat. Symptoms: dizziness, headache, anesthesia.

OSHA PEL: TWA, 200 ppm; ceiling, 300 ppm; max. peak, 500 ppm, 10 min.

ACGIH TLV: TWA, 100 ppm; STEL, 150 ppm.

IDLH: 2,000 ppm.

6.1.13. Tritium (^3H)

Half-Life:

Physical: 12.3 years.

Biological: ~10 days (range: 4–18) total body for HTO.

Special Chemical and Biological Characteristics: Not selectively concentrated in any organ. Metabolized as H_2O. Tritium is assumed to be readily and completely absorbed by the body and to be distributed evenly throughout the body. Tritium is a potential human carcinogen.

Principal Human Metabolic and Dosimetric Parameters:

f_1 (Absorption fraction) = 1.0.
ALI [Allowable life-time intake] (μCi) = 8.1×10^4 (HTO).
DAC (Derived air concentration) (μCi/cm^3) = 2.2×10^7 (HTO).

6.1.14. Natural and Depleted Uranium

Specific Activity: Natural uranium, 6.6×10^{-7} Ci/g.
Depleted uranium, 3.3×10^{-7} Ci/g.

Sources: Natural uranium is approximately 99.3% uranium-238 by weight.
Depleted uranium is approximately 99.7% uranium-238 by weight.

Exposure: Uranium presents both chemical and radiological hazards, depending upon the amount of enrichment and the chemical form (Table 1). In the case of depleted or natural uranium, relatively soluble compounds present heavy metal toxicity hazards similar to lead. The organ of concern for chemical hazards is the kidney. Relatively insoluble compounds (e.g., high-fired uranium oxides or metals) present chemical/radiological hazards. The organs of concern in this case are the lungs, bone, and kidney.

Table 1. Principal human metabolic parameters controlling uranium hazard.

Compound	Inhalation class[a]	ALI (ingestion) (μCi)	ALI (inhalation) (μCi)	DAC (μCi/cm^3)	DAC (mg/m^3)	Dominant hazard	ACGHI TLV-TWA (mg/m^3)
Nitrates, fluorides, chlorides, sulfates, acetate, UO_3	D	1.4×10^1	1.4	6.0×10^{-10}	0.8	Chemical	0.2
UF_4, U_3O_8, UO_2	W	1.4×10^1	0.81	8.1×10^{-9}	0.4	Chemical/ radiological	0.2
High-fired uranium oxides and metals	Y	1.9×10^2	5.4×10^{-2}	2.0×10^{-11}	0.03	Chemical/ radiological	0.2

[a] Inhalation Classes D, W, and Y are as defined in ICRP Publication 30 Part 1, *Annals of the ICRP, Limits for Intakes of Radionuclides by Workers*, 1979, Vol. 2, No. 3/4. In general, Class D compounds are cleared from the lungs in a matter of days, Class W compounds are cleared from the lungs within a few weeks, and Class Y compounds may take years to be cleared from the lungs.

6.1.15. Xylene

Odor: Like benzene; odor threshold, 0.05 ppm.

Fire Potential: Material is flammable and can form explosive mixtures with air.

Flammable Limits
Meta xylene—(XLM): LFL 1.1%, UFL 6.4%.
Ortho xylene—(XLO): LFL 1.1%, UFL 7.0%.
Para xylene—(XLP): LFL 1.1%, UFL 6.6%.

Exposure: Irritating to eyes, nose, and throat. Can readily be absorbed through intact skin. Symptoms: headache, dizziness, and coughing.

OSHA PEL: TWA, 100 ppm.

ACGIH TLV: TWA, 100 ppm; STEL, 150 ppm.

IDLH: 10,000 ppm.

6.2. Biological Hazards

Snake Bite

Rattlesnakes inhabit Site 300 and steps should be taken to protect workers through the use of snake chaps and high-top boots when appropriate. Anyone who has been bitten should be removed to a safe area. The individual should be kept calm. Notify the Emergency Dispatch (911) immediately. Arrangements have been established with Tracy Hospital for such an emergency to ensure the availability of antivenom serum.

Valley Fever

All persons who work at or visit Site 300 may be exposed to Valley Fever, a respiratory infection common throughout the San Joaquin Valley. All persons who work at Site 300 will be informed of their possible exposure to Valley Fever. Supervisors are responsible for ensuring that before assigning or hiring an employee to work at Site 300, for a short term or indefinitely, that the employee is referred to Health Services. Health Services will brief the individual regarding Valley Fever. Immunity or lack of immunity can be determined by a simple skin test. Health Services will inform the employee of the health risks associated with Valley Fever and a Site 300 assignment.

6.3. Physical Hazards

Working conditions at the site involve potential exposure to the physical hazards discussed below.

Mechanical Motions and Actions

A wide variety of mechanical motions and actions may present hazards to personnel. These can include the movement of rotating members, include the movement of rotating members, reciprocating arms, moving belts, meshing gears, cutting teeth, and any part that may cause impact

or shear. These different types of hazardous mechanical motions and actions are basic in varying combinations to nearly all machines.

Any machine part, function, or process which may cause injury shall be either guarded (physical barriers which prevent access to danger areas) or safeguarded (provided with devices which inhibit machine operation, to mitigate or eliminate danger areas).

Machine operators shall be trained in the proper use of equipment and associated guards/safeguards to protect themselves and others from machine-related hazards.

Machine operators shall wear protective clothing or personal protective equipment as necessary whenever engineering controls are not available or are not fully capable of protecting personnel. Protective equipment selected shall be:

- Appropriate for the particular hazards,
- Maintained in good condition,
- Properly stored when not in use to prevent damage or loss, and
- Kept clean, fully functional, and sanitary.

As a minimum, safety shoes and safety glasses shall be worn by all personnel operating or working within close proximity of heavy machinery or equipment. When there is a potential for head injury, hard hats shall be worn.

Excavations

Falls into open excavations and/or side wall collapse while personnel are inside the excavation are the major dangers. To minimize these hazards, excavations shall be barricaded and the walls properly sloped or shored according to OSHA requirements before personnel are allowed to enter the excavation. Personnel not directly involved in excavation activities shall remain at least ten feet away from the edge of an excavation. Excavated materials shall be kept at least 2 feet from the edge of the excavation. Plan work in or near excavations carefully and in consultation with the SSO about protective measures and equipment use. Individuals shall be properly trained prior to initiating work activities. See Appendix C for information on trench and excavation safety.

Overhead Power Lines

No equipment shall be operated closer than 15 feet in any direction to overhead power lines. Operation closer than 15 feet may be permitted only when overhead power lines have been de-energized, locked, and tagged out.

Underground Utilities

Site 300 Plant Engineering shall be notified of site activities in order to locate and mark any potentially hazardous underground utilities. In addition, an underground utilities locator supplied by Plant Engineering will identify buried lines prior to drilling.

Confined Space Entry

Although no confined space entries are currently anticipated, employees will be trained in what types of areas might be confined spaces. When entry into a confined space is necessary, Hazards Control will be contacted to obtain a confined space entry permit. The procedures required by the LLNL *Health and Safety Manual* Supplement 26.14, "Working in Confined Spaces," 29 CFR 1910.146–Permit Confined Spaces, and the ANSI Z117.89, "Safety Requirements for Confined Spaces" shall be followed.

Fire and Explosion

It is not anticipated that ground water and soil contaminants exist at concentrations sufficient to create fire and explosion hazards during routine drilling and sampling activities. Operating heavy equipment could create such hazards associated with fuel tank rupture. Such emergencies shall be handled as described in Section 7. Removal of underground tanks could create a potential for fire and explosion. Tank removal safety procedures will be addressed in an addendum to this Plan.

Several chemicals which may be encountered at the site during tank excavation are highly flammable liquids and present explosion hazards if vapors are present at levels above the lower explosive limit (LEL).

Chemical name	LEL (% by volume in air)
Benzene	1.3
Gasoline	1.4
Xylenes	1.0

To minimize explosion hazards, all tanks and piping will be emptied and flushed prior to excavation. All piping will be disconnected from tanks, the tanks emptied, and dry ice applied to the tank interior to displace oxygen prior to tank removal at the rate of 10 pounds of dry ice per 1,000 gallons of tank volume. The atmosphere inside the tank will be monitored with an oxygen meter prior to removal. At least one 20-pound dry chemical fire extinguisher will be available. No hot work or open flames will be allowed in the work area. It is anticipated that concentrations of these substances in fill or soil materials will be sufficiently low so as not to present a fire hazard. However, the detection of fuel products in fill and soil materials shall be cause to initiate the evaluation for vapors with respect to fire, explosion, and personnel exposure.

Electrical Hazards

Ignorance of basic electrical principles and misuse of electrical equipment contribute to many accidents. The human body's resistance can be drastically reduced by working with wet tools, in wet or damp locations, inside tanks and boilers, or around metal piping or other grounding materials. Other factors affecting the severity of electrical injuries include the path of the current through the body, the vital organs in that path, and the duration of the current through the body.

There are many ways an employee can come into contact with energized circuits. The most common of these are contact with exposed live parts and overhead or buried power lines. When working in the vicinity of live electrical parts, such as exposed wires, switches, or contacts, the parts must be guarded from contact by effective insulation or other means. Whenever possible, work on electrical equipment shall be performed in a totally de-energized state using lock and tag techniques as stipulated by Health and Safety Manual, Supplement 26.13, "General Lockout and Tagout Procedure." If a cognizant supervisor determines that work must be performed on energized equipment, the controls in Health and Safety Manual, Table 23-3 "Safety Controls Necessary for Electrical Work" must be followed. If that is not possible, the circuit must be de-energized and visibly grounded.

Pertinent information on electrical safety can be found in the ERD Electrical Safety Policy (Appendix E).

Noise

Noise exposure is primarily associated with heavy equipment, steam cleaning, and air compressors. Based upon previous experience, it is not anticipated that the noise levels will be of concern. Ear protection is provided for all field personnel and its use is encouraged when appropriate. Personnel may also experience impulse noise of up to 140 dB from explosives tests. Sound levels shall be monitored during the above operations and any other operation that generates hazardous noise levels.

Heat Stress

Heat stress is associated with exposure to high temperatures, wearing protective clothing, and physical exertion. Temperatures at the site can exceed 100°F on occasion. Drinking water is available on site and appropriate breaks shall be taken if temperature and levels of personal protection so dictate. Work should be conducted under umbrellas when appropriate to provide shade. Based upon previous experience and work performed at this site, it is not anticipated that heat stress will be a major concern when proper precautions are taken.

Personnel will inform the SSO of any symptoms of heat stress, such as:

- Weakness and fatigue.
- Dizziness.
- Nausea.
- Headache.

The SSO will be alert to signs of heat stress in site personnel and increase the frequency of breaks and fluid consumption as necessary. First aid care may require the following:

- Move victim to a cool environment.
- Loosen victim's clothing.
- If fainting seems likely, have the victim lie down with feet elevated 8 to 12 inches.
- Provide victim with sips of cool water or electrolyte drink such as Gatorade.
- In extreme cases, obtain medical assistance as quickly as possible.

The SSO shall determine the schedule of work and rest periods based on the temperatures at the work site. If there is any question as to the potential for heat stress during operations, the SSO shall contact the ES&H Team 1 industrial hygienist for any evaluation of the operational hazards and controls, including measurement of wet bulb globe temperature index.

Frostbite and Hypothermia

In cold environments, the body's metabolic rate must increase to maintain its thermal balance. Shivering increases the metabolic heat production and yet the feet, face, and hands still may feel cold. This often creates confusion for the exposed individual because he/she may be warmly clothed. Frostbite results from exposure to severe cold. It is more likely to occur when the wind is blowing. The nose, cheeks, ears, toes, and fingers are the body parts most frequently frostbitten. Hypothermia is the general cooling of the entire body.

To prevent frostbite and hypothermia:

- Dress warmly in cotton and wool clothing.
- Initiate work/rest regimens that ensure adequate protection from the cold.
- Drink hot fluids such coffee, tea, or soup.

Finally, obtain medical assistance when there is any doubt regarding the severity of exposure.

Explosives Hazards

Personnel could sustain injuries from blast fragments or heat should they be exposed to an accidental explosion or should they pick up an explosive. Personnel shall be made aware of the hazards involved with handling explosives. When possible, personnel shall remain at least at intraline distance from all explosives storage and operating facilities. Any work necessary within the intraline distance must follow the procedures outlined in Appendix G. Offices shall be at least at the inhabited building distance from all explosives storage and operating facilities.

6.4. General Safety Hazards

Other possible safety hazards include the potential for slipping, falling, head trauma, material handling, insect bites, etc. All personnel working on the project shall wear appropriate personal protective equipment (EPA Level D), including eye protection, head protection (hard hat), and steel-toed boots as required by the SSO. First aid is available onsite to take care of any minor injuries. The Emergency Dispatch (**911**) shall be contacted to deal with emergency situations more serious than cuts or scrapes.

Contact Emergency Response Dispatch (911) in emergency situations more serious than cuts or scrapes (from offsite, dial 510/447-6880).

6.5. Hazards to Non-Project Personnel

Potential risks to project personnel have been outlined above. Potential risks to other persons on the site who are not working on this project are exposure to vapors, gases, and chemicals in soil or ground water and the physical hazards associated with heavy equipment.

Air monitoring may be conducted to minimize the possibility of public and personnel exposure to vapors and gases. These procedures are described in Section 8. Due to the open air environment at the site and the fact that the work zone will be barricaded, the risk to the public and laboratory personnel is expected to be negligible.

7. Emergency Actions

7.1. Planning

The SSO shall plan escape routes and discuss them with project personnel before they enter a site to begin work. Initial planning includes establishing the best means for evacuation from the site in case of a catastrophe (e.g., explosion, tank rupture, fire, etc.).

7.2. Emergency Services

A tested system must be in place for rapid and clear distress communications, preferably voice, from all personnel to the emergency response unit of the LLNL Fire Department and the SSO. The SSO shall ensure that all personnel working at the site know how to communicate with the LLNL Emergency Response Dispatch at **911** (Offsite, dial **510/447-6880**). The SSO shall notify appropriate local emergency response units, and provide adequate and clear directions to reach LLNL work sites from the location of those units before beginning any onsite investigations or operations. All personnel shall have adequate and clear directions and access to personnel to local emergency services.

7.3. Evacuation

If evacuation is necessary, all personnel will proceed to a predetermined location in the support zone upwind of the work zone.

The predetermined evacuation route and assembly location will be specified at each site. ERD employees and subcontractors will evacuate the work site and not directly assist in handling the emergency.

The signal for evacuation will be three short blasts in succession on an air or car horn.

7.4. Emergency Evacuation From Contaminated Areas

Any person requiring medical attention shall be evacuated promptly from any contaminated area. However, personnel shall not enter an area to attempt a rescue if their own lives would also be threatened because of inadequate personal protection (e.g., oxygen-deficient atmosphere and no self-contained breathing apparatus). Contact the LLNL Emergency Response Dispatch at **911** to evacuate any person from any area of the site if necessary and to provide special decontamination treatment or procedures for any injured person. The SSO shall order evacuation of any person whose PPE fails.

Contact Emergency Response Dispatch at 911 for evacuation or decontamination treatment or procedures (from offsite, dial 510/447-6880).

7.5. First Aid

Qualified personnel shall give first aid and stabilize any employee needing assistance. Life support techniques such as CPR and treatment of life-threatening problems, such as bleeding, airway maintenance, and shock, shall be given top priority. Professional medical assistance shall be obtained at the earliest possible opportunity. If assistance beyond first aid is required, phone the LLNL Emergency Response Dispatch at **911**.

Maintain a first aid kit in the support zone. When drilling, items should be kept in a clean location near or on the drill rig.

Emergency first aid procedures for organic compounds.

Exposure	Procedures
Eyes	**Flush eyes immediately with fresh water for at least 15 minutes while holding the eyelids open. Call LLNL Emergency Response Dispatch at 911 immediately.**
Skin	**Wash skin thoroughly with soap and water. See a doctor if any unusual signs or symptoms or if any skin irritation occurs. Launder contaminated clothing.**
Inhalation	**Move exposed person to fresh air. If breathing has stopped, apply artificial respiration. Call LLNL Emergency Response Dispatch at 911 immediately.**
Ingestion	**If swallowed, DO NOT make person vomit. Call LLNL Emergency Response Dispatch at 911 immediately.**

7.6. Fire

Call the LLNL Fire Department at **911** in the event of any fire.

7.7. Hazardous Materials Spill

For spills of hazardous materials greater in volume than one gallon, call LLNL Emergency Response Dispatch at **911**. Refer to the appropriate MSDS (see Appendix C) for special instructions regarding cleanup or spills.

7.8. Guidelines

If any emergency involving actual or suspected personal injury occurs, the SSO, work supervisor, and surviving personnel shall follow these steps:

- Remove the exposed or injured person(s) from immediate danger—do not expose survivors to danger.
- Obtain paramedic service or ambulance transport to local hospital by calling the LLNL Emergency Response Dispatch at **911**. This procedure shall be followed even if there is no visible injury.
- Other personnel onsite shall be evacuated to a safe distance until the Fire Department determines that it is safe for work to resume.
- At the earliest time practicable, the SSO shall contact the Project Leader or designee and Hazards Control, giving details of the incident and the steps taken to prevent its recurrence.
- A written report of the incident must be forwarded to the Project Leader or designee within 24 hours following the incident.

Subsequent reporting shall be completed according to the requirements of the *LLNL Health and Safety Manual*, Section 4: Incident Analysis and Reporting.

8. Personal Protective Apparel and Equipment

Suggested item specifications and descriptions in this section are for information only. Equivalent items may be used.

8.1. Personal Protection

The nature of this work is such that several potentially hazardous conditions could be encountered. It is not always possible to determine in advance actual conditions and all protective requirements. Items specified below are intended to allow the SSO the latitude to provide a range of protection based upon actual working conditions. Where feasible, engineering controls in accordance with 29 CFR 1910, Subpart G and work practices are used to prevent exposure of employees to hazardous substances above their PEL or other published exposure limit if no PEL exists. However, when such is not feasible or not required, a reasonable combination of engineering controls, work practices, and PPE will be used. PPE selection is made to protect the employees from hazards or potential hazards at the site in accordance with 29 CFR 1910, Subpart I, Personal Protective Equipment.

The proper use and selection of PPE include consideration of at least the following items:

A. Proper usage procedure (i.e., donning and doffing).

B. Equipment limitations (i.e., reduced dexterity, vapor versus liquid contact, hazardous substance and concentration, and temperature).

C. Anticipated duration of use.

D. Maintenance and storage requirements.

E. Decontamination and disposal.

F. Inspection procedures.

G. Heat and cold stress, activity levels, and other medical considerations.

H. Employee training and fitting of equipment.

The use of employee rotation in order to achieve compliance of employee exposures to hazardous substances with PELs is not anticipated and would only be used when no other feasible means is available (i.e., a reasonable combination of engineering controls, work practices, PPE, etc.).

At a minimum, EPA Level D protection shall be worn during investigations at Site 300. It is not expected that higher levels of protection would be required often.

Depending upon the circumstances and the hazards present at a given site, the level of PPE will be determined by the Hazards Control Department. Some of the items recommended for a given level may be modified as appropriate (see Appendix F). The level of protection is selected based primarily upon:

A. Characteristics of hazardous substances (i.e., toxicity, concentration, entry routes, warning properties, etc.).

B. The potential for exposure in air, from splashes or from immersion in liquids, or other direct contact with hazardous substances.

Level D consists of a work uniform which provides minimal protection and essentially no protection against chemical hazards. It is used when no inhalation hazard is present nor anticipated to occur during the operations and skin contact with hazardous substances by immersion or splashes is not anticipated.

Many of the following items are only necessary for upgrading to Modified Level C protection. However, the SSO or designee shall ensure that all workers have all the following items available for their use:

- **Gloves**

  Inner, surgical type (vinyl disposable)

  Outer, chemical protective (neoprene or nitrile)

- **Protective clothing**

  Cotton, regular, washable coveralls

  AND Tyvek, regular, disposable, zippered coveralls

- **Footwear**

  Chemical protective boots (low-temperature vinyl), steel-toed

  OR safety shoes worn with protective rubber overshoes

- **Eye protection**

  Safety glasses with optional side-shields

  OR goggles

  OR single unit plastic "specs" with side-shields

- **Hard hat with attachable face shield (optional)**

- **Hearing protection**

  Muffs and/or earplugs

- **Respirators**

  National Institute for Occupational Safety and Health (NIOSH) approved full face mask air-purifying respirator equipped with a high-efficiency particulate filter (HEPA) with protection for organic vapors, acid gases, dusts, fumes, and mists, asbestos, and radionuclides. The protection for dusts, fumes, and mists shall be furnished for a TWA less than 0.05 mg/m^3.

  OR NIOSH-approved half-mask air-purifying respirator equipped with a HEPA filter with protection for organic vapors, acid gases, dusts, fumes, and mists, asbestos, and radionuclides. The protection for dusts, fumes, and mists shall be for a TWA less than 0.05 mg/m^3.

Conventional eyeglass frames cannot be used with full-face mask respirators because of interference with the face seal. Special eyeglasses can be mounted inside the face mask; however, there is a delay to obtain prescription lenses.

The SSO or designee shall specify which employees are required to wear the items listed above. The SSO or designee shall instruct site personnel to don appropriate respiratory protection when air monitoring results show breathing zone concentrations of benzene greater than 1 ppm, or when total hydrocarbon monitoring results for nonbenzene in the breathing zone are greater than 5 ppm. The SSO or designee shall determine which level of personal protective items (gloves, goggles, etc.) is needed, based on professional judgment regarding site conditions and the likelihood of exposure. Respiratory protection should be used if personnel exposure above TLVs is probable, or if personnel desire protection for odor or nuisance mitigation.

Personnel who wear respirators will be trained in their proper usage, have a current medical examination, and have been fit tested within the past 12 months. Facial hair which interferes with the respirator seal must be removed prior to respirator usage (29 CFR 1910.134 and LLNL Respiratory Protection Program).

It should be recognized that the nature of the potential hazards is such that it is not possible to provide maximum protection for all suspected contaminants. If unanticipated conditions are encountered that require additional personnel protection, the SSO or designee shall ensure that appropriate additional personal protective apparel and equipment are in use prior to continuing activities under those conditions.

8.2. Apparel Decontamination

If conditions warrant, the SSO or designee may establish at least one safety apparel decontamination station at the work site in the contamination reduction zone. Decontamination is defined as removing any potentially contaminated soil from boots by washing with soap and water or removing boot covers in the contamination reduction zone upon exiting the work zone

The location of the decontamination process will be selected to minimize the exposure of uncontaminated employees and equipment to the contaminated employees and equipment. The SSO or designee will monitor decontamination procedures to determine their effectiveness.

In the event that permeable clothing should become wetted with hazardous substances, the employee will immediately remove that clothing and proceed to shower.

If additional PPE is used, such as Polytyvek suits and chemical-resistant gloves, remove them in the contamination reduction zone after leaving the work zone. If this equipment is used, it must be decontaminated or disposed of properly.

8.3. Equipment Decontamination

Soils remaining on tools, sampling equipment, or heavy equipment will be removed by steam cleaning and/or soap and water. If there is reason to believe that the water used for this decontamination procedure requires containment and disposal, it will be contained and properly disposed of based upon analytical results.

8.4. Personnel Decontamination and Personal Hygiene

Personnel may be subject to skin or eye irritation from contaminants. Before eating, drinking, or smoking, site workers should thoroughly wash their hands and other exposed skin surfaces after leaving a contaminated area.

Where regular showers and change rooms are needed for decontamination outside of contaminated areas, they will meet the requirements of 29 CFR 1910.141, "SANITATION." Protective equipment and/or clothing will not be removed from change-rooms by unauthorized personnel.

8.5. Monitoring Equipment

The SSO or designee shall ensure that all necessary monitoring equipment is available in sufficient quantities prior to work initiation. The SSO or designee shall also ensure that these instruments are used only by personnel who have had prior experience with their care, calibration, and operation and who know their limitations. No work shall be done unless this instrumentation is available and in proper working order.

8.5.1. Monitoring Rationale

Monitoring shall be sufficient to determine:

- Airborne concentrations of hazardous chemical substances.
- Combustible gas and oxygen levels.
- Surface contamination of work areas.
- Contamination of personal protective apparel and equipment.
- Personnel contamination.
- Suitability of release of equipment and material to unrestricted areas.

8.5.2. Equipment

The SSO, or designee, may order the use of any or all of the following monitoring equipment to assist in evaluating potential hazards:

- Combustible gas/oxygen meter.
- Passive chemical dosimeters (i.e., 3M Organic Vapor Monitor, Draeger Direct-Reading Diffusion Tubes).
- Other real-time monitoring instruments (i.e., hydrogen sulfide, carbon monoxide, etc.).
- Photoionization detector (PID) or Organic Vapor Meter (OVM).
- Flame ionization detector (FID) or Organic Vapor Analyzer (OVA).
- Hand pump (e.g., Draeger) with colorimetric detector tubes for specific compounds, particularly benzene.

- Constant flow personnel air sampling pumps, which can be calibrated to appropriate volumetric air flow rates to collect airborne samples consistent with NIOSH requirements. The other items required for air sampling include: tubing, filter cassette holders, charcoal tubes, filters, and calibration equipment.
- Radiation detection equipment/monitors.

8.5.3. Initial Monitoring

A preliminary survey of existing air quality is performed by a qualified person to determine the presence of any of the following conditions prior to commencement of operations:

- Immediately dangerous to life and health (IDLH).
- Potential exposure to hazardous substance in excess of PEL or other published exposure limit when applicable.
- Exposure to radioactive substances in excess of established dose limits.
- Exposure to other dangerous conditions (i.e., flammable atmospheres or oxygen deficiency).

The site is initially inspected for visual signs of dangerous conditions and surveyed with appropriate instruments (OVM or OVA) prior to initiation of any work activities to establish background levels for use in proper selection of engineering controls, safe work practices, and PPE. Where radiation is anticipated, the site is also surveyed with radiation detection equipment.

If the presence of other hazardous substances not detectable with the above equipment is anticipated (hydrogen sulfide, carbon monoxide, etc.), the appropriate monitoring equipment will be used to survey the site (i.e., Drager detector tubes, substance-specific monitors, combustible gas/oxygen meter, etc.).

This survey will focus on the following areas:

- The contamination reduction zone downwind from drilling activities, excavation, and other work activities.
- Locations where workers may assemble or congregate.
- Confined spaces or areas where gases may be trapped.

8.5.4. Periodic Monitoring

When the potential for exposure is unknown, periodic monitoring of onsite ambient concentrations of VOCs in the immediate vicinity of work activities will be performed using a OVM or OVA. The SSO or designee will compare monitoring results with OSHA standards, and other exposure guidelines, if monitoring indicates the possibility of exceeding exposure limits.

Where work activities may generate dust contaminated with beryllium or lead, it may be necessary to use a calibrated sampling pump to collect an airborne sample of particulate on a filter. When this is done, samples should be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory according to NIOSH procedures.

Caution is necessary during any fuel tank excavation and removal. OVM or OVA results are not compound specific; the instrument reading is for total organic vapors. When benzene is a potential exposure problem, a direct readout of benzene vapor concentrations should be obtained using an instrument similar to a Draeger pump with a colorimetric detector tube specific for benzene. Personnel protection, respirator selection, monitoring, and operational protocols and procedures must be developed for work atmospheres where benzene concentrations are greater than the PEL of 1 ppm.

Periodic monitoring shall be performed whenever there is a possibility that an IDLH condition or explosive atmosphere has developed or when an indication that exposure may be in excess of the PEL or other published exposure limits. When any of following situations exist, additional precautions shall be considered:

- Initiation of work in a different portion of the site.
- If new contaminants are known to be, or suspected of being present.
- When employees are handling leaking containers or working in areas with obvious contamination.
- Upon initiation of a different type of operation.

8.5.5. High Risk Employees

The employees who are most likely to be exposed to hazardous substances above the PEL or other applicable published exposure limits will be monitored first. If they are being exposed to levels above the PEL, then monitoring will be performed to establish which other employees, if any, may also be exposed above the PEL.

8.5.6. Perimeter Monitoring

Under certain circumstances, it may be necessary to conduct perimeter monitoring to evaluate emissions resulting from work covered by this SSP. If such monitoring is conducted and results are higher than baseline levels of any contaminant, immediate steps will be taken to determine the cause, make changes to site operations, evacuate unprotected personnel and the public, if necessary, and notify agency contact personnel. Specific protocols to be implemented shall be determined by the SSO and the Project Leader for each incident.

8.6. First Aid and Safety Equipment

To provide first response assistance to field personnel in the event of an injury or illness, the SSO or designee shall have the following items immediately available at the site investigation command post, or at work areas, as appropriate:

- First aid kit.
- First aid handbook.
- Portable emergency eyewash station or bottles.
- Supply of clean water.
- Hand soap, or waterless hand cleaner, and clean hand towels.
- Portable cooler with drinking water (or replenishment drink such as Gatorade) and ice.

9. Personnel Training

Individuals assigned to this project who may be exposed to physical and chemical hazards shall undergo training to:

- Ensure that the health and safety of LLNL employees, contract employees, employees or representatives of other agencies, and the public is maintained.
- Safeguard the health and safety of all employees and the public by complying with all laws, rules, and regulations.
- Increase the ability of employees to react responsibly to emergencies and to handle emergency situations in a safe manner.
- Increase the ability of employees to complete their work in an efficient and timely manner.

9.1. General

All personnel working on ERD cleanup sites at LLNL who may be exposed to physical and chemical hazards shall attend 40 hours of health and safety training, 24 hours of on-the-job field training under supervision, or other combinations deemed equivalent by the SSO, as specified in OSHA 29 CFR 1910.120. Personnel will be trained prior their participation in field activities and written certificates are to be issued upon successful completion of that training. The Project Leader, SSO, and supervisors are required to complete an additional eight hours of "Hazardous Waste Supervisors" training. All site personnel are required to complete eight hours of "Refresher" training annually.

Instructors shall have completed a training program for the subjects that they are expected to teach or have academic credentials and instructional experience for teaching the subjects.

The above requirements address minimal training needs and additional training will be provided as deemed appropriate.

At a minimum, worker training should address the following topics:

- Names of personnel and alternates responsible for site health and safety.
- Onsite Medical Surveillance and Signs of Overexposure.
- Elements of the SSP and any applicable OSP.
- Program Discussion/Regulatory Overview.
- Training Rationale.
- Chemical and Physical Hazards.
- Toxicology.
- Medical Surveillance Program.
- Environmental Planning

Hazards Analysis
Work Plan
Site Safety Plan.

- Characterization and Site Activities.
- Site Control.
- Personal Protective Equipment

  Clothing
  Respirators and Fit Testing.

- Air Monitoring.
- Decontamination.
- Emergencies.
- Site Operations.
- Hazardous Substance Identification.
- Hazard Communication Program.

9.2. Work Site Specific Topics

All site personnel (LLNL employees and contract) shall attend a site-specific training session which addresses: nature and degree of exposure anticipated at the site; prohibited practices; emergency procedures; site-specific safety requirements; and general safety requirements.

9.2.1. Prohibited Practices

The following practices must be strictly observed at all times during the project work. The prohibitions shall remain in effect from the time of entry into the work site until after leaving that portion of the site. They include:

- Eating, chewing, drinking, or use of tobacco products will not be allowed past the Contamination Control Line (i.e., "Hotline"). Avoid all hand-to-mouth contact when your clothing or body may be contaminated (i.e., be careful until *after* showering). Any open wounds must be covered with an air-tight bandage; ideally, someone with an open wound should not enter a work site. Persons with lesions or sores in the mouth, eyes, or nose shall not enter the work site.
- Never climb over or under any refuse or obstacles.
- Facial hair that may interfere with the satisfactory fit of respiratory protective equipment will not be allowed. Workers with beards will not be allowed to do work requiring respiratory protection.
- Personnel may not wear loose, ragged, or poorly fitted clothing, dangling jewelry, or rings when working around equipment or tools. Long hair must be restrained so that it does not get caught in moving parts. Any of these items can become snagged in moving equipment and result in serious injury.

- Alcohol and/or drugs are not permitted at the site. Any person reporting to work under the influence of alcohol and/or illegal drugs will be permanently prohibited from working at the site.

The following prohibitions and practices shall be in effect when deemed necessary by the SSO due to the existence of hazardous conditions at the work area:

- Do not wear contact lenses. Eye contamination while wearing contact lenses can result in serious injury to the eye before the lens can be removed and the eye properly washed.
- Practice contamination avoidance: never sit down or kneel, never place equipment on contaminated surfaces, avoid obvious sources of contamination such as puddles, avoid unnecessary contact with on-site objects.
- Do not start or maintain an open flame of any type unless authorized.
- No employee may enter a work site alone or work alone without prior approval. Special work tasks, such as water level measurements or water sampling, may require that an individual work alone. In such cases, procedures shall be developed delineating emergency response and communication activities and responsibilities.

In addition to the prohibitions and practices listed above, the SSO may impose any other prohibitions that may be required for safe operations.

9.2.2. Emergency Procedures and Services

The training session should include:

- LLNL Emergency Response Dispatch (**911**).
- Signals, alarms, and hazard signs.
- Evacuation routes and procedures.
- Assembly points.
- Buddy system.
- Communications.
- Fire protection.
- Barricades and scaffolds.
- Emergency equipment.
- First aid and contaminated wounds.
- Spills.

Refer to page 1 of this document for emergency telephone numbers and Section 7 of this document for emergency procedures.

9.2.3. General Safety Requirements

All project work shall be performed in a manner consistent with providing a safe work environment. General safety guidelines are to:

- Wear appropriate protective clothing for the job, including, but not limited to, hard hat, work clothing, safety shoes, and eye protection.
- Decontaminate known sources of contamination (such as gloves and boots) at the appropriate location as specified by the SSO. Remove equipment only after decontamination or containerization onsite.
- Keep track of weather conditions and wind direction when working outside.
- Plan activities thoroughly ahead of time: enter work sites by a designated route only to get to a designated point for a specific purpose.
- Always use the buddy system: never enter or exit alone, and never work alone in an isolated area.
- Always maintain contact with the SSO and the ERD offices (T-8726), where site access and operations are controlled.
- Shower thoroughly as soon as possible after removing protective equipment.
- Wash hands thoroughly upon leaving any area of suspected contamination.
- All personal safety equipment is to be inspected prior to work site entrance. The condition of the equipment must be acceptable to the SSO.
- All personnel who will enter a work site should wear secure identification (e.g., badge with photo and name; name on clothing). A name on the hard hat is *not* secure identification. Identification must be visible even when all PPE or gear is worn.
- Never assume that a situation is as safe as it appears to be.
- Be alert to any unusual behavior on the part of other workers that might indicate distress, disorientation, or other ill effects. Be alert to any unusual changes in your own condition; never ignore warning signs or hesitate to report them at once. Inform each other of symptoms of nausea, dizziness, headache, or respiratory or eye irritation.
- Maintain a clean and organized work area.
- Delineate work zones with barricades and markers.
- Label raw materials, debris, scrap, waste, intermediates, and contaminated clothing with appropriate and understandable precautionary labels.
- Post warnings in areas with high noise levels and require PPE.
- Inspect fire extinguishers monthly for adequate pressure.
- Only trained and experienced operators are to operate heavy equipment onsite.

9.3. Field Briefings

The SSO, or designee, shall conduct daily health and safety field briefings that include:

- Work activities that day.
- Health and safety requirements for that day.

- Work zones.
- Evacuation routes.
- Assembly point upwind of work area, in case of emergency or evacuation.
- Emergency signals.
- Location of first aid and emergency safety equipment.

9.4. First Aid

The SSO, or designee, shall identify those individuals who have previously completed training programs in First Aid and CPR. These individuals should be appointed as alternates for the SSO if he/she is incapacitated or needs assistance. Specific responsibilities will be assigned to these individuals by the SSO, who will take into consideration their familiarity with the following topics:

- Principles of first aid.
- Restoration of breathing/CPR.
- Control of bleeding.
- Recognition and treatment of physical shock.
- Open and closed wounds and burns.
- Fractures and dislocations.

10. Operations

Operations shall be conducted in a safe manner consistent with the policies and procedures outlined in this SSP. The number of personnel shall be restricted to the minimum necessary to complete the required work as an administrative control to limit the exposure of personnel to hazards onsite.

10.1. Work Site Practices

The prohibited practices and general safety requirements listed in Section 9 are applicable to this site work. In addition, no worker may engage in any activity for which the health and safety consequences of his/her actions are unclear (e.g., previously unplanned work) without the approval of the SSO. If such activities become necessary to complete any phase of the work, a project instruction or procedure shall be developed and followed.

Smoking will not be permitted in any restricted work location or other locations posted "No Smoking" by LLNL.

10.2. Work Zones

Site access shall be controlled to reduce the possibility of entry by unauthorized or unprotected individuals and prevent the transfer of contaminants by personnel or equipment from the site. Three zones, the exclusion zone, the contamination reduction zone, and the support zone, will be delineated by barricades and flagging as appropriate. Zones will be established by the SSO or designee based on local conditions. In most situations, such as during drilling operations in small, individual areas, only a barrier delineating the exclusion zone and the support zone will be needed.

The SSO or designee will be alert to persons entering active zones and will prohibit unauthorized or unprotected persons from entering these zones. Zones may be modified or expanded by the SSO depending upon changing wind and site conditions.

10.2.1. Exclusion Zone

The exclusion zone shall include, at a minimum, the immediate vicinity of the work area (such as the drill rig and the boring location at the rear of the rig) plus an additional 15-foot corridor. Persons entering this zone are required to wear PPE as prescribed by the SSO for that particular zone.

10.2.2. Contamination Reduction Zone

The contamination reduction zone shall be located upwind of the exclusion zone. The purpose of this zone is to prevent the transfer of contaminants by personnel or equipment exiting the exclusion zone. All decontamination activities shall occur in this area.

In the case of drill rig activities, a separate contamination reduction zone may not be necessary. It will usually suffice to establish a decontamination point at the entrance/exit to the barricade

around the drill site. Personnel may discard any contaminated articles before stepping outside of the barrier into the support zone (the remainder of the site).

10.2.3. Support Zone

The support zone is the outermost zone and is considered a noncontaminated (or clean) area. Any supplies, equipment, or personnel required to support site activities should be kept in this zone. The support zone shall be upwind of the contamination reduction and exclusion zones.

10.3. Security Measures

All areas and containers where potentially contaminated soil or water are to be stored unattended and any excavations that are to be left open and unattended are to be surrounded by a barricade to prevent accidental access by unauthorized personnel. Potentially contaminated material shall be properly packaged and labeled.

10.4. Hazard Control Measures

Specific considerations shall be given to the following topics to ensure that adequate hazard control measures are implemented for site operations:

- Minimization of dust generation (e.g., applying water when excavating or drilling).
- Prevention of surface contamination by subsurface material or vice versa.
- Decontamination of sampling equipment.
- Decontamination of excavation/construction/maintenance equipment.
- Decontamination and disposal of personnel protective apparel and equipment.
- Use of decontamination solutions–acids, alkalis, or solvents.
- Disposal of decontamination solutions and other materials used on equipment, surfaces, or systems.
- Disposal of drilling spoils and other wastes associated with environmental characterization.
- Disposal of contaminated materials by placing them in 55-gallon drums, which may be sealed, labeled, and disposed of as necessary.
- Monitoring for flammable/explosive vapors.
- Minimization of personnel exposures through appropriate use of administrative work practices.
- Handling and disposal of contaminated water, filtrates, etc.
- Use and operation of electrical equipment (see Appendix E).
- Use and maintenance of personnel protective apparel and equipment.
- Trench and excavation safety (see Appendix D).

- Personnel air monitoring protocols for evaluation of full-shift and short-term chemical exposures.
- Direct reading instrumentation protocols and techniques for estimating real-time chemical exposures onsite.
- Respiratory protection as per 29 CFR 1910.134 and ANSI Z88.2.

The Hazards Control Department, Safety Team Four, can be contacted for guidance and evaluation.

10.5. Fire Protection

To ensure that fire and explosion hazards are minimized, plans and procedures must be coordinated with the LLNL Fire Department (911). If suitable water supplies are unavailable or where water use may be inappropriate, 20- or 30-lb ABC fire extinguishers may be necessary for each drill rig or field crew. No smoking is allowed in the work area nor near any flammable materials. Any use of open flame requires prior authorization by the SSO.

Employees are informed of the fire hazards of the materials and processes to which they are exposed. Upon initial assignment, each employee will be trained in the portions of the fire prevention plan that will protect the employee in the event of an emergency.

The hazardous work sites at LLNL have the fire hazards typical of construction sites and chemical treatment facilities such as: combustible and flammable materials, potential for explosive atmospheres, occasional welding and open flames, oxidizers, and motor fuels.

The LLNL Fire Department and the SSO or designee are responsible for the maintenance of any fire prevention and suppression systems or equipment used on the hazardous work sites.

The accumulation of flammable and combustible waste materials will be minimized as a means of fire prevention.

10.6. Communications

The SSO or designee shall maintain contact with workers on a continuing basis. Individuals shall meet and register at the checkpoint established by the SSO prior to work site entry. Each worker shall ensure that he maintains contact with other workers or his "buddy." No individual may either enter or leave the work site alone. Exiting workers shall inform the SSO, or designee, that they are departing.

10.7. Personnel Protection Plan

Environmental operations pose unusual health and safety problems. A very careful review of OSHA and EPA regulations, standards, and guidelines by the SSO is important. At a minimum, these requirements may include:

- Medical surveillance.
- Personnel exposure monitoring program.
- Respiratory protection.

- PPE and clothing.
- Prohibited activities.
- Compliance program.
- Hygiene facilities and practices.
- Employee information and training.
- Recordkeeping.

10.8. Safety

The industrial health and fire safety aspects of this program will focus on evaluation of hazards associated with:

- Transportation equipment.
- Material handling equipment.
- Machinery and parts.
- Hand tools and pressurized equipment.
- Hazardous supplies and materials.
- Fire protection.
- Electrical equipment (i.e., motors, relays, and starters).

Prior to the initiation of work and weekly thereafter, safety inspections will be conducted by the SSO or designee. This inspection will include those activities necessary to ensure the safe operating condition of all equipment consistent with 29 CFR 1910 and 1926 and the LLNL Health and Safety Manual. Additionally, it will be the responsibility of LLNL's subcontractors to provide a routine maintenance program for their equipment.

10.9. Recordkeeping

Health and safety records shall be maintained in accordance with applicable regulatory requirements. Records are maintained for LLNL personnel at the LLNL Environmental Protection Department offices: these records document safety training, medical surveillance, respiratory protection training and testing, injuries, and illnesses. All subcontractors working on the project are required to maintain similar records at their respective offices.

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Priority Toxic Pollutants –Health Impacts and Allowable Limits, Sittig, M. (1980), Noyes Publications.

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Appendix A

Site-Specific Operational Safety Procedures

Appendix A

Site-Specific Operational Safety Procedures

The Site-Specific Operational Safety Procedures (OSPs) supplements the LLNL Site 300 Safety Plan (SSP) and provides detailed information for a specific operation not fully addressed in the SSP. A copy of the OSP shall be kept at the work site at all times. The OSPs typically includes the following items as applicable and any additional items deemed necessary:

A. Hazard Assessment For Each Task in Work Plan.

B. Personal Protective Equipment For Each Task.

C. Type and Frequency of Air Monitoring.

D. Site Control Measures.

E. Decontamination Procedures.

F. Spill Containment Program.

G. Employee Training Assignments.

H. Confined Space Entry Procedures.

I. Emergency Response Procedures.

J. Site Inspections.

K. Medical Surveillance.

L. Pre-Entry Briefing.

Appendix B

Acronyms

Appendix B

Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ALARA	As low as reasonably achievable
ALI	Annual limit on intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPR	Cardiopulmonary resuscitation
DAC	Derived air concentration
DOE	Department of Energy
DTSC	California Department of Tox Substances Control
EPA	Environmental Protection Agency
ERD	Environmental Restoration Program and Division
ES&H	Environmental Safety and Health
FID	Flame Ionization Detector (OVA)
f_1	Alternative gastrointestinal-tract absorption factor
HE	High explosives
HEPA	High efficiency particulate filter
IDLH	Immediately dangerous to life or health concentration which represents the maximum level from which one could escape within 30 minutes without any escape-impairing symptoms or any other irreversible health effects.
LEL/UEL -	Lower and upper explosive limits. Percent by volume of potentially explosive substance in air.
LFL/UFL -	Lower and upper flammable limits. Percent by volume of potentially flammable substance in air.
LLNL	Lawrence Livermore National Laboratory
MSDS	Material Safety Data Sheets
NIOSH	National Institute for Occupational Safety and Health.
OSHA	Occupational Safety and Health Administration.
OSPs	Operational Safety Procedures
OVA	Organic Vapor Analyzer
OVM	Organic Vapor Meter (PID)

PEL — Permissible exposure limit set by OSHA. Values usually are expressed in ppm or mg/m^3. PELs are expressed as:

(1) 8-hr TWA exposure limit

(2) Ceiling exposure limit: at no time shall an employee's exposure exceed this limit

(3) Short-term exposure limit (STEL)

(4) Maximum peak: acceptable above the specified ceiling limit for the stated concentration and duration.

PID — Photoionization detector (PID)

PPE — Personal protective equipment

QA — Quality Assurance

QAMP — Quality Assurance Management Plan

QAPP — Quality Assurance Project Plan

QIF — Quality Improvement Form

RCRA — Resource Conservation and Recovery Act

SOP — Standard Operating Procedure

SSO — Site Safety Officer

SSP — Site Safety Plan

TLV — Threshold limit value as issued by ACGIH. Values usually are expressed in ppm or mg/m^3. TLVs are expressed as:

(1) TLV-TWA: the TWA concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

(2) TLV-STEL: the 15-min TWA to which a worker can be exposed for a period of up to 15 minutes continuously without suffering from irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue, or materially reduce worker efficiency, and provided that the daily TLV-TWA is not exceeded.

TWA — Time-weighted average. This is generally expressed as an 8-hour TWA.

VOCs — Volatile organic compounds

Appendix C

Material Safety Data Sheets

Appendix C

Material Safety Data Sheets

Benzene

Beryllium

Cyclotrimethylenetrinitramine (RDX)

Diesel Fuel No. 2

Gasoline, Automotive, Unleaded

Hydrochloric Acid

Hydrodesulfurized Kerosine

Lead

Nitric Acid

Tetrachloroethylene

Toluene

Trichloroethylene

Tritiated Water

Xylene


MDL Information Systems, Inc,

MSDS: BENZENE

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 71-43-2
RTECS NUMBER: CY1400000

SUBSTANCE: BENZENE

TRADE NAMES/SYNONYMS:
BENZOL; CYCLOHEXATRIENE; BENZOLE; PHENE; PYROBENZOL; PYROBENZOLE; CARBON OIL; COAL TAR NAPHTHA; PHENYL HYDRIDE; BENZOLENE; BICARBURET OF HYDROGEN; COAL NAPHTHA; MOTOR BENZOL; ANNULENE; (6)ANNULENE; MINERAL NAPHTHA; NITRATION BENZENE; RCRA U019; UN 1114; STCC 4908110; C6H6; OHS02610

CHEMICAL FAMILY:
Hydrocarbon, aromatic

CREATION DATE: 10/11/84 REVISION DATE: 10/26/95

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : BENZENE
CAS NUMBER: 71-43-2
PERCENTAGE: >99

OTHER CONTAMINANTS: 0.15% NON-AROMATICS; 1 PPM THIOPHENE

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2  REACTIVITY=0
NFPA Ratings: Health=2 Fire=3 Reactivity=0

EMERGENCY OVERVIEW:
Colorless to light-yellow liquid with an aromatic odor.
Cancer hazard (contains material which can cause cancer in humans). Risk of cancer depends on duration and level of exposure. Causes respiratory tract, skin, and eye irritation. May cause blood disorders. May affect the central nervous system.
Flammable liquid and vapor. May cause flash fire.
Do not breathe vapor or mist. Do not get in eyes, on skin, or on clothing. Keep away from all ignition sources. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include ringing in the ears, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, drunkenness, disorientation, numbness, twitching, blurred vision, lung congestion, blood disorders, paralysis, convulsions, shock and coma.
LONG TERM EFFECTS: In addition to effects from short term exposure, low blood pressure, hearing loss, visual disturbances and brain damage may occur. May also cause reproductive effects and cancer.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include blisters.
LONG TERM EFFECTS: In addition to effects from short term exposure, tingling sensation may occur.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: In addition to effects from short term exposure, cataracts may occur.
INGESTION:
SHORT TERM EFFECTS: May cause nausea, vomiting, chest pain, headache, drowsiness, drunkenness, disorientation, twitching, visual disturbances, lung congestion, paralysis, convulsions and coma.
LONG TERM EFFECTS: In addition to effects from short term exposure, impotence may occur. May also cause cancer.

CARCINOGEN STATUS:
OSHA: Y
NTP: Y
IARC: Y

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Maintain airway, blood pressure and respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with

soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- Extreme care must be used to prevent aspiration. Gastric lavage with a cuffed endotracheal tube in place to prevent further aspiration should be done within 15 minutes. In the absence of depression or convulsions or impaired gag reflex, emesis can also be induced using syrup of ipecac without increasing the hazard of aspiration (Dreisbach, Handbook of Poisoning, 12th Ed.). Treat symptomatically and supportively. Gastric lavage should be performed by qualified medical personnel. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Dangerous fire hazard when exposed to heat or flame.

Moderate explosion hazard when exposed to heat or flame.

Vapor-air mixtures are explosive.

Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.

Due to low electroconductivity of the substance, flow or agitation may generate electrostatic charges resulting in sparks with possible ignition.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 27).

Extinguish only if flow can be stopped. Use water in flooding quantities as a fog; solid streams may spread fire. Cool containers with flooding amounts of water; apply from as far a distance as possible. Avoid breathing hazardous materials; keep upwind. Evacuate to a radius of 1500 feet for uncontrolable fires. Consider evacuation of downwind area if material is leaking.

Water may be ineffective. (NFPA 325, Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids, 1994).

FLASH POINT: 12 F (-11 C) (CC)
LOWER FLAMMABLE LIMIT: 1.2%
UPPER FLAMMABLE LIMIT: 7.8%
AUTOIGNITION: 928 F (498 C)
FLAMMABILITY CLASS(OSHA): IB

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of carbon.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Stop leak if you can do it without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area. Keep unnecessary people away; isolate hazard area and restrict entry.

Reportable Quantity (RQ): 10 pounds
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SOIL SPILL:
Dig holding area such as lagoon, pond or pit for containment.
Dike flow of spilled material using soil or sandbags or foamed barriers such as polyurethane or concrete.
Use cement powder, fly ash, sawdust or commercial sorbent to absorb bulk liquid.
Reduce vapor and fire hazard with fluorocarbon water foam.

AIR SPILL:
Knock down vapors with water spray. Keep upwind.

WATER SPILL:
Limit spill motion and dispersion with natural barriers or oil spill control booms.
Apply detergents, soaps, alcohols or another surface active agent to thicken spilled material.
Apply universal gelling agent to immobilize trapped spill and increase efficiency of removal.

If dissolved, apply activated carbon at ten times the spilled amount in the region of 10 ppm or greater concentration.
Use suction hoses to remove trapped spill material.
Use dredges or lifts to extract immobilized masses of pollution and precipitates.

The California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) prohibits contaminating any known source of drinking water with substances known to cause cancer and/or reproductive toxicity.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 29 CFR 1910.106.

Bonding and grounding: Substances with low electroconductivity, which may be ignited by electrostatic sparks, should be stored in containers which meet the bonding and grounding guidelines specified in NFPA 77-1983, Recommended Practice on Static Electricity.

Protect against physical damage. Outside or detached storage is preferable. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials (NFPA 49, hazardous chemicals data, 1975).

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
BENZENE:
1 ppm OSHA TWA; 5 ppm OSHA 15 minute STEL; 0.5 ppm OSHA action level
10 ppm (30 mg/m3) ACGIH TWA;
ACGIH A2-Suspected Human Carcinogen
(Notice of Intended Changes 1994-95)
0.1 ppm (0.32 mg/m3) NIOSH recommended 8 hour TWA;
1 ppm (3.2 mg/m3) NIOSH recommended 15 minute ceiling

Measurement method: Charcoal tube; carbon disulfide; gas chromatography with flame ionization detection; (NIOSH III # 1500, Hydrocarbons, also # 3700).

10 pounds CERCLA Section 103 Reportable Quantity
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting
Subject to California Proposition 65 cancer and/or reproductive toxicity warning and release requirements- (February 27, 1987)

VENTILATION:
Provide local exhaust or process enclosure ventilation to meet the published

exposure limits. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

Benzene:
Ventilation should meet the requirements in 29 CFR 1910.1028(f).

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

BENZENE:
Protective eye equipment should meet the requirements for protective clothing and equipment in 29 CFR 1910.1028(h).

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

BENZENE:
Protective clothing should meet the requirements for personal protective equipment in 29 CFR 1910.1028(h).

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

BENZENE:
Protective gloves should meet the requirements for personal protective equipment in 29 CFR 1910.1028(h).

RESPIRATOR:
The following respirators are the minimum legal requirements as set forth by the Occupational Safety and Health Administration found in 29 CFR 1910, Subpart Z.

BENZENE:

Concentration:	Required respirator:
Less than or equal to 10 ppm-	Half-mask air-purifying respirator with organic vapor cartridge.
Less than or equal to 50 ppm-	Full facepiece respirator with organic vapor cartridges. Full facepiece gas mask with chin style canister.
Less than or equal to 100 ppm-	Full pacepiece powered air-purifying respirator with organic vapor canister.
Less than or equal to 1000 ppm-	Supplied air respirator with full facepiece in positive-pressure mode.
Greater than 1000 ppm or	

unknown
concentration- Self-contained breathing apparatus with full facepiece in positive-pressure mode.
Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.

Escape- Any organic vapor gas mask.
Any self-contained breathing apparatus with full facepiece.

Firefighting- Full facepiece self-contained breathing apparatus in positive-pressure mode.

The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH pocket guide to chemical hazards, or NIOSH criteria documents.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

BENZENE:
At any detectable concentration:
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Colorless to light-yellow liquid with an aromatic odor.
MOLECULAR WEIGHT: 78.11
MOLECULAR FORMULA: C6-H6
BOILING POINT: 176 F (80 C)
FREEZING POINT: 42 F (6 C)
VAPOR PRESSURE: 75 mmHg @ 20 C
VAPOR DENSITY: 2.8
SPECIFIC GRAVITY: 0.8765 @ 20 C

WATER SOLUBILITY: 0.18% @ 25 C
VOLATILITY: 100%
PH: no data available
ODOR THRESHOLD: 4.68 ppm
EVAPORATION RATE: (butyl acetate=1) 5.1
VISCOSITY: 0.6468 cP @ 20 C
SOLVENT SOLUBILITY: Soluble in acetone, alcohol, carbon disulfide, ether, carbon tetrachloride, chloroform, acetic acid, oils, and organic solvents.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
Avoid contact with heat, sparks, flames, or other sources of ignition. Vapors may be explosive. Avoid overheating of containers; containers may violently rupture in heat of fire. Avoid contamination of water sources.

INCOMPATIBILITIES:
BENZENE:
ACIDS (STRONG): Incompatible.
ALLYL CHLORIDE WITH DICHLOROETHYL ALUMINUM OR ETHYLALUMINUM SESQUICHLORIDE: Possible explosion.
ARSENIC PENTAFLUORIDE + POTASSIUM METHOXIDE: Explosive interaction.
BASES (STRONG): Incompatible.
BROMINE + IRON: Incompatible.
BROMINE PENTAFLUORIDE: Fire and explosion hazard.
BROMINE TRIFLUORIDE: Possible explosion or ignition.
CHLORINE: Explosion in the presence of light.
CHLORINE TRIFLUORIDE: Violent reaction with possible explosion.
CHROMIC ANHYDRIDE (POWDERED): Ignition.
DIBORANE: Spontaneously explosive reaction in air.
DIOXYGEN DIFLUORIDE: Ignition, even at reduced temperatures.
DIOXYGENYL TETRAFLUOROBORATE: Ignition reaction.
INTERHALOGEN COMPOUNDS: Ignition or explosion.
IODINE HEPTAFLUORIDE: Ignition on contact.
IODINE PENTAFLUORIDE: Violent interaction above 50 C.
NITRIC ACID: Violent or explosive unless properly agitated and cooled.
NITRYL PERCHLORATE: Explosive interaction.
OXIDIZERS (STRONG): Fire and explosion hazard.
OXYGEN (LIQUID): Explosive mixture.
OZONE: Formation of explosive gelatinous ozonide.
PERCHLORATES (METAL): Formation of explosive complex.
PERCHLORYL FLUORIDE + ALUMINUM CHLORIDE: Formation of shock sensitive compound.
PERMANGANATES + SULFURIC ACID: Possible explosion.
PERMANGANIC ACID: Explosion hazard.
PEROXODISULFURIC ACID: Explosion hazard.
PEROXOMONOSULFURIC ACID: Explosive interaction.
POTASSIUM PEROXIDE: Ignition.
SILVER PERCHLORATE: Formation of explosive complex.
SODIUM PEROXIDE + WATER: Ignition.
URANIUM HEXAFLUORIDE: Violent reaction.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of carbon.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

BENZENE:
IRRITATION DATA: 20 mg/24 hours skin-rabbit moderate; 15 mg/24 hours open skin-rabbit mild; 88 mg eye-rabbit moderate; 2 mg/24 hours eye-rabbit severe.
TOXICITY DATA: 2 pph/5 minutes inhalation-human LCLo; 65 mg/m3/5 years inhalation-human LCLo; 100 ppm inhalation-human TCLo; 150 ppm/1 year intermittent inhalation-man TCLo; 10000 ppm/7 hours inhalation-rat LC50; 300 ppm/6 hours/13 weeks intermittent inhalation-rat TCLo; 300 ppm/6 hours/99 weeks intermittent inhalation-rat TCLo; 9980 ppm inhalation-mouse LC50; 221 ppm/6 hours/7 days intermittent inhalation-mouse TCLo; 10 ppm/6 hours/10 weeks intermittent inhalation-mouse TCLo; 300 ppm/6 hours/13 weeks intermittent inhalation-mouse TCLo; 300 ppm/6 hours/16 weeks intermittent inhalation-mouse TCLo; 100 ppm/6 hours/72 weeks intermittent inhalation-mouse TCLo; 146000 mg/m3 inhalation-dog LCLo; 170000 mg/m3 inhalation-cat LCLo; 45000 ppm/30 minutes inhalation-rabbit LCLo; 20000 ppm/5 minutes inhalation-mammal LCLo; 1000 ppm/7 hours/28 weeks-intermittent inhalation-rat TCLo; 100 ppm/6 hours/3 weeks-intermittent inhalation-pig TCLo; 25 ppm/6 hours/5 days-intermittent inhalation-mouse TCLo; 500 ppm/6 hours/3 weeks-intermittent inhalation-rat TCLo; 23 mg/kg/4 hours/8 days-intermittent inhalation-rat TCLo; >9400 mg/kg skin-rabbit LD50; >9400 mg/kg skin-guinea pig LD50; 48 mg/kg skin-mouse LD50; 50 mg/kg oral-man LDLo; 6600 mg/kg/27 weeks intermittent oral-rat TDLo; 4700 mg/kg oral-mouse LD50; 930 mg/kg oral-rat LD50; 2 gm/kg oral-dog LDLo; 17 gm/kg/17 weeks-intermittent oral-rat TDLo; 4250 mg/kg/17 weeks-intermittent oral-mouse TDLo; 2197 mg/kg/5 days-intermittent subcutaneous-rat TDLo; 13536 mg/kg/12 weeks-intermittent subcutaneous-rat TDLo; 18 mg/kg/21 days-intermittent subcutaneous-rat TDLo; 5700 mg/kg oral-mammal LD50; 88 mg/kg intravenous-rabbit LDLo; 2890 ug/kg intraperitoneal-rat LD50; 340 mg/kg intraperitoneal-mouse LD50; 527 mg/kg intraperitoneal-guinea pig LDLo; 1500 mg/kg intraperitoneal-mammal LDLo; 194 mg/kg unreported-man LDLo; mutagenic data (RTECS); reproductive effects data (RTECS).
CARCINOGEN STATUS: OSHA Carcinogen; Known Human Carcinogen (NTP); Human Sufficient Evidence, Animal Sufficient Evidence (IARC Group-1). Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene.
LOCAL EFFECTS: Irritant- inhalation, skin, eye.
ACUTE TOXICITY LEVEL: Moderately toxic by ingestion; slightly toxic by inhalation and dermal absorption.
TARGET EFFECTS: Central nervous system depressant; bone marrow depressant.

Poisoning may also affect the immune system and the heart.
AT INCREASED RISK FROM EXPOSURE: Persons with certain immunological tendencies, poor nutrition, anemia and drug or chemically induced agranulocytemia.
ADDITIONAL DATA: Use of alcoholic beverages may enhance the toxic effects. Use of stimulants such as epinephrine may cause cardiac arrhythmias. May cross the placenta. Interactions with medications have been reported.

HEALTH EFFECTS
INHALATION:
BENZENE:
IRRITANT/NARCOTIC/BONE MARROW DEPRESSANT/CARCINOGEN.
ACUTE EXPOSURE- Concentrations of 3000 ppm may cause respiratory tract irritation; more severe exposures may result in pulmonary edema. Systemic effects are mainly on the central nervous system and depend on exposure time and concentration. No effects were noted at 25 ppm for 8 hours; signs of intoxication began at 50-150 ppm within 5 hours; at 500-1500 ppm, within 1 hour; were severe at 7500 ppm, within 30-60 minutes; and 20,000 ppm was fatal within 5-10 minutes. Effects may include nausea, vomiting, headache, dizziness, drowsiness, weakness, sometimes preceded by a brief period of exhilaration or euphoria, irritability, malaise, confusion, ataxia, staggering, weak, rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips, and tinnitus. In severe exposures there may be blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis, and coma characterized by motor restlessness, tremors and hyperreflexia, sometimes preceded by convulsions. Recovery depends on the severity of exposure. Polyneuritis may occur and there may be persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia, and agitation. Nervous irritability, breathlessness, and unsteady gait may persist for 2-3 weeks; a peculiar skin color and cardiac distress may persist for 4 weeks. Liver and kidney effects may occur, but are usually mild, temporary impairments. Chromosomal damage has been found after exposure to toxic levels. Although generally hematotoxicity is not a significant concern in acute exposure, delayed hematological effects, including anemia and thrombocytopenia, have been reported, as have petechial hemorrhages, spontaneous internal bleeding and secondary infections. In fatal exposures, death may be due to asphyxia, central nervous system depression, cardiac or respiratory failure and circulatory collapse, or occasionally, sudden ventricular fibrillation. It may occur within a few minutes to several hours, or cardiac arrythmia may occur at anytime within 24 hours. Also, death from central nervous system, respiratory or hemorrhagic complications may occur up to 5 days after exposure. Pathologic findings have included respiratory inflammation with edema and hemorrhage of the lungs, renal congestion, cerebral edema, and extensive petechial hemorrhages in the brain, pleurae, pericardium, urinary tract, mucous membranes, and skin.
CHRONIC EXPOSURE- Longterm exposure may cause symptoms referable to the central nervous, hematopoietic and immune systems. Early effects are vague and varied and may include headache, light-headedness, dizziness, nausea, anorexia, abdominal discomfort, and fatigue. Sore, dry throat, weakness, lethargy, malaise, drowsiness, nervousness, and irritability have also been reported. Later there may be dyspnea, pallor, slightly increased temperature, decreased blood pressure, rapid pulse, palpitations, and visual disturbances. Dizziness when cold water is placed in the ear and hearing impairment have been reported, as have diffuse cerebral atrophy associated with ataxia, tremors and emotional lability. Workers exposed to benzene in combination with other solvents have exhibited polyneuritis. Several case reports, one of them an acute exposure, suggest the possibility that systemic exposure may be associated with retrobulbar or optic neuritis. Occasionally hemorrhages in retina and conjunctiva

occur and rarely neuroretinal edema and papilledema have accompanied the retinal hemorrhages. Hematological effects vary widely and may appear after a few weeks or many years of exposure or even many years after exposure has ceased. The degree of exposure below which no blood effects will occur cannot be established with certainty. In the early stages, there may be blood clotting defects due to morphological, functional and quantitative platelet alteration with resultant bleeding from the nose and gums, easy bruising and petechiae; leukopenia with predominant lymphocytopenia or neutropenia; and anemia which may be normochromic or macrocytic and hypochromic. Extramedullary hematopoiesis, splenomegaly, circulating immature marrow cells, and an initial increase in leukocytes, erythrocytes and platelets have also been reported. The bone marrow may be hyper-, hypo- or normoplastic and does not always correlate with the peripheral blood picture. Also, the symptoms do not always parallel the laboratory findings. If treated at this stage, the effects appear reversible, although recovery may be protracted and there may be relapses. Decreased erythrocyte survival, hemolysis, capillary fragility, internal hemorrhages, iron metabolism disturbances, and hyperbilirubinemia have also been reported. Exposure to high levels for longer periods may result in aplasia and fatty degeneration of the bone marrow with pancytopenia. The most serious cases of aplastic anemia may be fatal due to hemorrhage and infection; death may occur within 3 months of diagnosis. Enormous variability in individual response, including non-dose dependent aplasia, and the finding of eosinophilia suggests that, in some cases, the blood dyscrasia may partially be an allergic reaction. Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene. Several studies have also suggested a link between occupational exposure and multiple myeloma and lymphoma, both Hodgkin's and nonhodgkin's. Although aplastic anemia is probably the more likely consequence of longterm exposure, it is not uncommon for an individual surviving this, to go through a preleukemic phase into frank leukemia. Conversely, leukemia without precedent aplastic anemia can occur. In one study the range of time from the start of the exposure to the diagnosis of leukemia was 3-24 years. It has been suggested that the chromosomal aberrations which can arise in peripheral blood and bone marrow cells and persist for a long time after exposure ceases, may be associated with the increased incidence of leukemia. The immunosuppressive effect has also been suggested as being associated with the leukemogenesis. Adverse effects on the immunological system have been shown to make rabbits more susceptible to tuberculosis and pneumonia and may explain why the terminal event in some cases of benzene intoxication may be overwhelming infection. Exposed mice exhibited a tendency toward induction of lymphoid neoplasms. Rats exhibited an increased incidence of neoplasms, mainly carcinomas, at various sites. Menstrual disturbances have been reported more frequently in exposed women. Testicular damage has been reported in rats, rabbits and guinea pigs. Some animal studies have demonstrated embryo/fetotoxicity, sometimes at levels as low as 10 ppm and the potential for teratogenic effects such as decreased body weight and skeletal variants, have also been shown. Other studies have not produced any abnormalities or embryolethality.

SKIN CONTACT:
BENZENE:
IRRITANT.
ACUTE EXPOSURE- Direct contact may cause irritation. Effects may include

erythema, a burning sensation, and with prolonged contact, blistering and edema. Under normal conditions, significant signs of systemic toxicity are unlikely from skin contact alone due to the slow rate of absorption; it may however, contribute to the toxicity from inhalation. Application to guinea pigs resulted in increased dermal permeability.

CHRONIC EXPOSURE- Repeated or prolonged contact defats the skin and may result in dermatitis with erythema, scaling, dryness, vesiculation, and fissuring, possibly accompanied by paresthesias of the fingers which may persist several weeks after the dermatitis subsides. Peripheral neuritis has also been reported. Secondary infections may occur. Tests on guinea pigs indicate sensitization is possible. Although animal studies have failed to establish a relationship between skin contact and a carcinogenic effect, most of the studies were inadequate; some papillomas and hematopoietic effects have been reported.

EYE CONTACT:
BENZENE:
IRRITANT.

ACUTE EXPOSURE- May cause irritation. Vapor concentrations of 3000 ppm are very irritating, even on brief exposure. Droplets cause a moderate burning sensation, but only a slight, transient corneal epithelial injury with rapid recovery.

CHRONIC EXPOSURE- Repeated or prolonged exposure may cause conjunctivitis. 50% of rats exposed to 50 ppm for more than 600 hours developed cataracts.

INGESTION:
BENZENE:
NARCOTIC/CARCINOGEN.

ACUTE EXPOSURE- May cause local irritation and burning sensation in the mouth, throat and stomach, and hemorrhagic inflammatory lesions of the mucous membranes in contact with the liquid. Signs and symptoms of systemic intoxication may include nausea, vomiting, headache, dizziness, weakness, staggering, chest pain and tightness, shallow, rapid pulse and respiration, breathlessness, pallor followed by flushing, and a fear of impending death. There may be visual disturbances, tremors, convulsions, ventricullar irregularities, and paralysis. Excitement, euphoria or delirium may precede weariness, fatigue, sleepiness and followed by stupor and unconsciousness, coma and death from respiratory failure. Those who survive the central nervous system effects may develop bronchitis, pneumonia, pulmonary edema, and intrapulmonary hemorrhage. Aspiration may cause immediate pulmonary edema and hemorrhage. The usual lethal dose in humans is 10-15 milliliters, but smaller amounts have been reported to cause death. A single exposure may produce longterm effects with pancytopenia persisting up to a year.

CHRONIC EXPOSURE- Daily administration to humans of 2-5 grams in olive oil caused headache, vertigo, bladder irritability, impotence, gastric disturbances, and evidence of renal congestion. In female rats treated with 132 single daily doses over 187 days, no effects were observed at 1 mg/kg; slight leukopenia at 10 mg/kg; and both leukopenia and anemia at 50 and 100 mg/kg. Oral administration to rats and mice at various dose levels induced neoplasms at multiple sites in males and females. In a one year gavage study, rats given 50 or 250 mg/kg, 4-5 days/week for 52 weeks did not exhibit acute or subacute toxic effects, but a dose correlated increase of leukemias and mammary carcinomas was observed; some other tumor types were also reported. Reproductive effects have been reported in animals.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40CFR 262. EPA Hazardous Waste Number U019.

Benzene - Regulatory level: 0.5 mg/l (TCLP-40 CFR 261 Appendix II) materials which contain the above substance at or above the TCLP regulatory level meet the EPA toxicity characteristic, and must be disposed of in accordance with 40 CFR part 262. EPA Hazardous Waste Number D018.

US EPA RCRA Hazardous Waste Number: RCRA U019

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Benzene-UN 1114

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
3 - Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 5 L
CARGO AIRCRAFT ONLY: 60 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
BENZENE		10 pounds RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
BENZENE		
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	Y	
BENZENE		

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	Y
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MDL Information Systems, Inc.

MSDS: BERYLLIUM

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 7440-41-7
RTECS NUMBER: DS1750000

SUBSTANCE: BERYLLIUM

TRADE NAMES/SYNONYMS:
BERYLLIUM-9; GLUCINIUM; BERYLLIUM ELEMENT; GLUCINUM; RCRA P015; UN 1567; BE; OHS02910

CHEMICAL FAMILY:
Metal

CREATION DATE: 03/22/85 REVISION DATE: 01/06/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : BERYLLIUM
CAS NUMBER: 7440-41-7
PERCENTAGE: 100.0

OTHER CONTAMINANTS: NONE

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=3  REACTIVITY=0
NFPA Ratings: Health=3 Fire=1 Reactivity=0

EMERGENCY OVERVIEW:
Odorless, grayish-white brittle metal.
Cancer hazard (contains material which can cause cancer in humans). Risk of

cancer depends on duration and level of exposure. Causes respiratory tract, skin, and eye irritation. May cause (severe) allergic respiratory reaction. May form flammable or explosive dust-air mixtures. Flammable solid. Do not breathe dust. Do not get in eyes, on skin, or on clothing. Keep away from all ignition sources. Keep container tightly closed. Avoid creation of dust. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. May cause allergic reactions. May cause effects as reported in long term exposure. Additional effects may include fever, difficulty breathing, irregular heartbeat, bluish skin color and lung congestion.
LONG TERM EFFECTS: In addition to effects from short term exposure, chills, bloody spit, chest pain, wheezing, low blood pressure, lung damage, kidney damage and convulsions may occur. May also cause cancer.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: Same effects as short term exposure.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: May cause shortness of breath.
LONG TERM EFFECTS: No information available on significant adverse effects.

CARCINOGEN STATUS:
OSHA: N
NTP: Y
IARC: Y

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- If vomiting occurs, keep head lower than hips to help prevent aspiration. Treat symptomatically and supportively. Get medical attention if needed.

NOTE TO PHYSICIAN
ANTIDOTE:
The following antidote has been recommended. However, the decision as to whether the severity of poisoning requires administration of any antidote and actual dose required should be made by qualified medical personnel.

BERYLLIUM POISONING:
The administration of calcium disodium edetate has been suggested. Give 15-25 mg/kg (0.08-0.125 mL of 20% solution per kilogram body weight) in 250-500 mL of 5% dextrose intravenously over a 1 to 2 hour period twice daily. The maximum dose should not exceed 50 mg/kg/day. The drug should be given in 5-day courses with a rest period of at least 2 days between courses. After the first course, subsequent courses should not exceed 50 mg/kg/day. Daily urinalyses should be done during the treatment period. The dosage should be reduced if any unusual urinary findings appear.
For intramuscular administration, give 12.5 mg/kg body weight every 4-6 hours. Dilute each dose with an equal volume of 1% procaine. Dose limitation is the same as that given above (Dreisbach, Handbook of Poisoning, 12th Ed.). Antidote should be administered by qualified medical personnel.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Negligible fire hazard in bulk form; however, dust, powder, or fumes are flammable or explosive when exposed to heat or flames.

Dust-air mixtures may ignite or explode.

EXTINGUISHING MEDIA:
dry sand, dolomite, graphite, sodium chloride, soda ash, or dry powder

Do not apply water to burning material. (NFPA Fire Protection Handbook, 16th Edition).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 32).

Extinguish using agent for type of fire. Avoid breathing fumes from burning material.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition releases highly toxic fumes of beryllium oxide.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
For large spills, sweep up with a minimum of dusting and place into suitable clean, dry containers for reclamation or later disposal.

Residue should be cleaned up using a high-efficiency particulate filter vacuum.

Reportable Quantity (RQ): 10 pounds
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

WATER SPILL:
The California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) prohibits contaminating any known source of drinking water with substances known to cause cancer and/or reproductive toxicity.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in a cool, dry, well-ventilated location. Separate from acids, bases, halocarbons, oxidizing materials. (NFPA 49, Hazardous Chemicals Data, 1991).

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
BERYLLIUM AND COMPOUNDS, (as Be):
2 ug/m3 OSHA TWA; 5 ug/m3 OSHA ceiling; 25 ug/m3 OSHA 30 minute peak
2 ug/m3 ACGIH TWA
ACGIH A2-Suspected Human Carcinogen
Not to exceed 0.5 ug/m3 NIOSH recommended exposure criteria

Measurement method: Particulate filter; acid; flameless atomic absorption with a high-temperature graphite analyzer; (NIOSH III # 7102).

Subject to SARA Section 313 Annual Toxic Chemical Release Reporting

Subject to California Proposition 65 cancer and/or reproductive toxicity warning and release requirements- (October 1, 1987)

BERYLLIUM:
10 pounds CERCLA Section 103 Reportable Quantity

VENTILATION:
Process enclosure ventilation recommended to meet published exposure limits. Ventilation equipment must be explosion-proof.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

BERYLLIUM AND COMPOUNDS (AS BE):
At any detectable concentration:
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Escape- Any air-purifying, full-facepiece respirator with a high-efficiency particulate filter.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Odorless, grayish-white brittle metal.
MOLECULAR WEIGHT: 9.01
MOLECULAR FORMULA: BE
BOILING POINT: 5378 F (2970 C) @ 5 mmHg
MELTING POINT: 2323-2341 F (1273-1283 C)
VAPOR PRESSURE: 7.6 mmHg @ 1910 C
VAPOR DENSITY: not applicable
SPECIFIC GRAVITY: 1.848
WATER SOLUBILITY: insoluble in cold; decomposes in hot
PH: not applicable
ODOR THRESHOLD: no data available
EVAPORATION RATE: not applicable
SOLVENT SOLUBILITY: Soluble in dilute acids, alkalies; insoluble in nitric acid, mercury.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
May react exothermically on contact with hot water.

CONDITIONS TO AVOID:
Avoid dispersion of dust in air. Finely divided particles, dust, or fumes may be flammable or explosive. Keep away from sparks or ignition sources.

INCOMPATIBILITIES:
BERYLLIUM:
ACIDS (STRONG): Reacts to produce flammable hydrogen gas.
BASES (STRONG): Attacked and evolves flammable hydrogen gas.
CARBON DIOXIDE: Violent reaction.
CARBON DIOXIDE + NITROGEN: May ignite on heating.
CARBON TETRACHLORIDE: Forms shock-sensitive mixture.
CHLORINE: Incandescent reaction when heated.
FLUORINE: Incandescent reaction when heated.
HALIDES: Reacts.
HALOCARBON SOLVENTS: May form shock-sensitive mixtures.
HYDROCHLORIC ACID: Reacts with finely divided or amalgamated beryllium.
LITHIUM: Severely attacks beryllium metal.
METALS (ALKALI): Reacts to form salts.
NITRIC ACID (DILUTE): Reacts with finely divided or amalgamated beryllium.
OXIDIZERS: Reacts vigorously.
PHOSPHORUS: Incandescent reaction on heating.
SULFURIC ACID (DILUTE): Reacts with finely divided or amalgamated beryllium.
TRICHLOROETHYLENE: Forms shock-sensitive mixture.

HAZARDOUS DECOMPOSITION:
Thermal decomposition releases highly toxic fumes of beryllium oxide.

POLYMERIZATION:

Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

BERYLLIUM:
TOXICITY DATA: 496 ug/kg intravenous-rat LD50; mutagenic data (RTECS); tumorigenic data (RTECS).
CARCINOGEN STATUS: Anticipated Human Carcinogen (NTP); Human Sufficient Evidence, Animal Sufficient Evidence (IARC Group-1). Occupational exposure to beryllium and its compounds has resulted in an increased risk of lung cancer. Exposure by inhalation or intratracheal instillation resulted in lung tumors in rats. Rabbits receiving intravenous injections, implantations, or injections into the bone resulted in osteosarcomas.
LOCAL EFFECTS: Irritant- inhalation, skin, eyes.
ACUTE TOXICITY LEVEL: Insufficient data.
TARGET EFFECTS: Sensitizer- respiratory. Poisoning may affect the spleen, liver, kidneys, and heart.
AT INCREASED RISK FROM EXPOSURE: Persons with chronic lung disease.
ADDITIONAL DATA: May cross the placenta. Contact with beryllium compounds may exacerbate a preexisting berylliosis condition.

HEALTH EFFECTS
INHALATION:
BERYLLIUM:
IRRITANT/SENSITIZER/CARCINOGEN.
4 mg(Be)/m3 Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- Brief, intense exposure to pulmonary irritants may cause severe chemical pneumonitis. Symptoms may include bronchial spasm, nasopharyngitis, tracheobronchitis, cough, blood tinged sputum, dyspnea, cyanosis, nasal discharge, fever, anorexia, fatigue, tachycardia and possibly cor pulmonale. Fatal pulmonary edema or spontaneous pneumothorax have been reported. Studies in rats indicate a severe, chemical pneumonitis followed by a quiescent period of minimal inflammation and mild fibrosis occurs. Later, progressive fibrosing pneumonitis was observed in these rats. With sufficient exposure, effects as detailed in chronic exposure may occur.
CHRONIC EXPOSURE- In addition to the effects described in acute exposure, prolonged or repeated exposure may cause "berylliosis", a disorder that generally affects the upper and lower respiratory tract, but the onset may be marked by weakness, fatigue, and weight loss with or with dyspnea. Symptoms may be delayed from 1-25 years from exposure and may be precipitated by additional physical stress. Signs of pulmonary insufficiency and systemic effects may occur including dyspnea on on exertion or at rest, burning chest pain, constant non-productive hacking cough, wheezing, clubbing of fingers, low blood pressure, enlarged liver, spleen and parotid gland, osteoarthropathy, increase in hematocrit, elevated serum uric acid, nephrolithiasis, hypercalciuria with or without stones, hypercalcemia, spontaneous skin lesions, and cor pulmonale due to increasing pulmonary fibrosis and pulmonary resistance. Less common effects may include hemoptysis, seizure disorders and palpitations. Severely disabled persons may show cachexia and signs of right heart impairment with severe non-productive cough, spontaneous pneumothorax, and bouts of chills and fever. Death may be due to cardiac or respiratory failure, or in rare cases, renal failure. Pathological

findings include extrapulmonary changes of focal granulomatous lesions in the abdominal lymph nodes, spleen, liver, and bone marrow, as well as renal involvement. Human studies indicate that berylliosis may be a disease resulting from pulmonary sensitization and responding with inflammatory changes which tend to be granulomatous. Cumulative exposure to beryllium has produced decreased lung function that is distinct from berylliosis. Epidemiological studies show an excess of lung cancer in white males occupationally exposed to beryllium or beryllium compounds.

SKIN CONTACT:
BERYLLIUM:
IRRITANT.
ACUTE EXPOSURE- May cause irritation. Sensitization is reported to not occur from contact of intact skin with beryllium metal. However, accidential implantation of particles beneath the skin may cause necrosis of adjacent tissue, formation of ulcer, and granulomatous hypersensitivity reaction.
CHRONIC EXPOSURE- Repeated exposure to irritants may cause dermatitis.

EYE CONTACT:
BERYLLIUM:
IRRITANT.
ACUTE EXPOSURE- Contact with dust may cause conjunctival inflammation. Introduction into corneas of rabbits produced slight clouding of the surrounding cornea.
CHRONIC EXPOSURE- May cause conjunctivitis and possibly severe periorbital edema.

INGESTION:
BERYLLIUM:
ACUTE EXPOSURE- May cause coughing and shortness of breath. Experimental evidence suggest that little beryllium is absorbed from the gastrointestinal tract.
CHRONIC EXPOSURE- In animal studies, beryllium metal eaten in the diet at a level of 5% is so poorly absorbed that no effect on growth occurred over long periods of feeding. However, beryllium tends to displace magnesium in the body after a prolonged period of time.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40CFR 262. EPA Hazardous Waste Number P015.

US EPA RCRA Hazardous Waste Number: RCRA P015

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Beryllium, powder-UN 1567

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
6.1 - Poisonous materials

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Poison, flammable solid

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: None
NON-BULK PACKAGING: 49 CFR 173.212
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 15 kg
CARGO AIRCRAFT ONLY: 50 kg

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
BERYLLIUM		10 pounds RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
BERYLLIUM AND COMPOUNDS, (as Be)		
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	Y	
BERYLLIUM AND COMPOUNDS, (as Be)		

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	Y
REACTIVITY HAZARD:	Y
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MDL Information Systems, Inc.

MSDS: CYCLOTRIMETHYLENETRINITRAMINE

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 121-82-4
RTECS NUMBER: XY9450000

SUBSTANCE: CYCLOTRIMETHYLENETRINITRAMINE

TRADE NAMES/SYNONYMS:
1,3,5-TRIAZINE, HEXAHYDRO-1,3,5-TRINITRO-;
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE;
S-TRIAZINE, HEXAHYDRO-1,3,5-TRINITRO-; HEXAHYDRO-1,3,5-TRINITRO-S-TRIAZINE;
CYCLONITE; CYCLOTRIMETHYLENENITRAMINE; SYM-TRIMETHYLENETRINITRAMINE;
TRIMETHYLENETRINITRAMINE; HEXOGEN; RDX; T4; C3H6N6O6; OHS05990

CHEMICAL FAMILY:
Amine, alicyclic

Nitro

CREATION DATE: 06/27/86 REVISION DATE: 04/04/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : CYCLOTRIMETHYLENETRINITRAMINE
CAS NUMBER: 121-82-4
PERCENTAGE: 100.0

OTHER CONTAMINANTS: NONE

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2  REACTIVITY=4
NFPA Ratings: Health=2 Fire=3 Reactivity=4

EMERGENCY OVERVIEW:
White, odorless crystalline powder.
Harmful if swallowed.
May explode from heat, shock or friction.
Do not grind or subject to heat or shock. Keep away from heat, sparks, and flame. Avoid breathing dust. Avoid contact with eyes, skin and clothing. Avoid contamination by any source. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: May cause nausea, vomiting, headache, dizziness, loss of memory and convulsions.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: May cause effects as reported in long term inhalation. Same effects as short term exposure.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: No information is available.
INGESTION:
SHORT TERM EFFECTS: May be harmful if swallowed.
LONG TERM EFFECTS: May cause effects as reported in long term inhalation. Additional effects may include twitching and convulsions.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- If vomiting does not completely empty the stomach, proceed with the

following: Induce emesis with syrup of ipecac and water. When vomiting occurs, keep head lower than hips to help prevent aspiration. Do not give anything by mouth or induce vomiting if person is unconscious or otherwise unable to swallow. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider performing gastric lavage (Dreisbach & Robertson; Handbook of Poisoning; 12th Ed.).

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Dangerous fire hazard when exposed to heat or flame.

Dangerous explosion hazard when exposed to heat or flame.

EXTINGUISHING MEDIA:
Flood with water. If no water is available use halon, dry chemical or earth. (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Do not move containers if exposure to heat has occurred. Do not fight fire when it reaches storage or cargo area. Withdraw from area and let fire burn. If possibility exists that Class A explosives are involved, evacuate to a distance of 3/4 mile for tractor/trailer load; 1 mile for a railcar load. (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 46).

Dangerously explosive. Do not fight fire in cargo area, evacuate area and let burn. Avoid breathing dusts and fumes. Evacuate to a radius of 5000 feet if material on fire or involved in a fire.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of nitrogen.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Do not touch spilled material. No smoking, flames or flares in hazard area. Evacuate area for 2500 feet in all directions. Keep unnecessary people away.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store away from incompatible substances.

Store in accordance with 27 CFR Subpart K and 29 CFR 1910.109.

Consult NFPA publication 495, Explosives, Storage and Use, for proper storage and handling requirements.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
CYCLOTRIMETHYLENETRINITRAMINE:
1.5 mg/m3 OSHA TWA (skin) (vacated by 58 FR 35338, June 30, 1993)
1.5 mg/m3 ACGIH TWA (skin)
1.5 mg/m3 NIOSH recommended 10 hour TWA (skin);
3 mg/m3 NIOSH recommended STEL

Measurement method: Particulate filter; gravimetric; (NIOSH III Nuisance dust # 0500 (total)).

VENTILATION:
Provide local exhaust or process enclosure ventilation to meet the published exposure limits. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators are recommended based on information found in the physical data, toxicity and health effects sections. They are ranked in order from minimum to maximum respiratory protection.
The specific respirator selected must be based on contamination levels found

in the work place, must be based on the specific operation, must not exceed the working limits of the respirator and must be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

Any dust and mist respirator.

Any air-purifying respirator with a high-efficiency particulate filter.

Any powered air-purifying respirator with a dust and mist filter.

Any powered air-purifying respirator with a high-efficiency particulate filter.

Any type 'C' supplied-air respirator operated in the pressure-demand or other positive pressure or continuous-flow mode.

Any self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: White, odorless crystalline powder.
MOLECULAR WEIGHT: 222.12
MOLECULAR FORMULA: (C-H2-N2-O2)3
BOILING POINT: not available
MELTING POINT: 401-403 F (205-206 C)
VAPOR PRESSURE: negligible
VAPOR DENSITY: not applicable
SPECIFIC GRAVITY: 1.82
WATER SOLUBILITY: insoluble
PH: not applicable
ODOR THRESHOLD: no data available
EVAPORATION RATE: not applicable
SOLVENT SOLUBILITY: Soluble in acetone; slightly soluble in ether, ethyl acetate, glacial acetic acid, methanol; insoluble in alcohol, carbon disulfide, and carbon tetrachloride.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
CYCLOTRIMETHYLENETRINITRAMINE:
Exposure to heat, friction, shock, or electrostatic discharge may initiate detonation.

CONDITIONS TO AVOID:
Do not allow fire to reach cargo area.

INCOMPATIBILITIES:
CYCLOTRIMETHYLENETRINITRAMINE:
ACIDS: Incompatible.
ALKALIS: Incompatible.
GLASS: Incompatible.
SAND: Incompatible.
MERCURY FULMINATE: May easily initiate an explosion.
METAL FRAGMENTS: Incompatible.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of nitrogen.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

CYCLOTRIMETHYLENETRINITRAMINE:
TOXICITY DATA: 85 mg/kg oral-child TDLo; 100 mg/kg oral-rat LD50; 59 mg/kg oral-mouse LD50; 500 mg/kg oral-rabbit LDLo; 100 mg/kg oral-cat LDLo; 3600 mg/kg/90 days continuous oral-rat TDLo; 2275 mg/kg/13 weeks continuous oral-rat TDLo; 28800 mg/kg/90 days continuous oral-mouse TDLo; 1800 mg/kg/6 weeks intermittent oral-dog TDLo; 18 mg/kg intravenous-rat LDLo; 19 mg/kg intravenous-mouse LD50; 25 mg/kg intravenous-guinea pig LD50; 10 mg/kg intraperitoneal-rat LDLo; reproductive effects data (RTECS).
CARCINOGEN STATUS: None.
ACUTE TOXICITY LEVEL: Toxic by ingestion.
TARGET EFFECTS: Poisoning may affect the central nervous system.

HEALTH EFFECTS
INHALATION:
CYCLOTRIMETHYLENETRINITRAMINE:
ACUTE EXPOSURE- May cause irritation of the respiratory tract.
CHRONIC EXPOSURE- Workers exposed have experienced epileptiform convulsions or became unconscious without convulsions. The premonitory symptoms included headache, dizziness, nausea, and vomiting. When consciousness was regained (within a few minutes to 24 hours) intermittent stupor, weakness, and nausea continued. Seizures were followed by temporary post convulsive amnesia, malaise, fatigue, and asthenia. A few days of irritability, insomnia, or restlessness may also precede convulsions.

SKIN CONTACT:
CYCLOTRIMETHYLENETRINITRAMINE:
ACUTE EXPOSURE- May cause irritation.

CHRONIC EXPOSURE- Repeated or prolonged exposure may cause effects as in chronic inhalation. Primary and sensitizing dermatitis has been reported, however likely caused by impurities or chemical intermediates associated with its production.

EYE CONTACT:
CYCLOTRIMETHYLENETRINITRAMINE:
ACUTE EXPOSURE- May cause irritation.
CHRONIC EXPOSURE- No data available.

INGESTION:
CYCLOTRIMETHYLENETRINITRAMINE:
TOXIC.
ACUTE EXPOSURE- The lethal dose reported in rats was 100 mg/kg. The symptoms were not reported.
CHRONIC EXPOSURE- Repeated ingestion may cause effects as in chronic inhalation. Rats fed diets containing up to 600 mg/kg/day for 13 weeks experienced hypotriglyceridemia, hyperreactivity, tremors, convulsions and death. An apparent dose related incidence of leukocytosis occurred in females. Multifocal degenerative testicular lesions were seen in males fed 300 or 600 mg/kg/day. Reproductive effects have been reported in animals.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA Hazardous Waste Number D003.
100 pound CERCLA Section 103 Reportable Quantity.

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
None - forbidden explosives

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	N
SARA SECTION 302 (40CFR355.30):	N
SARA SECTION 304 (40CFR355.40):	N
SARA SECTION 313 (40CFR372.65):	N
OSHA PROCESS SAFETY (29CFR1910.119):	N
CALIFORNIA PROPOSITION 65:	N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	Y
REACTIVITY HAZARD:	Y
SUDDEN RELEASE HAZARD:	Y

SECTION 16

OTHER INFORMATION

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MDL Information Systems, Inc.

MSDS: CYCLOTETRAMETHYLENETETRANITRAMINE

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 2691-41-0
RTECS NUMBER: XF7450000

SUBSTANCE: CYCLOTETRAMETHYLENETETRANITRAMINE

TRADE NAMES/SYNONYMS:
OCTAHYDRO-1,3,5,7,-TETRANITRO-1,3,5,7,-TETRAZOCINE; HMX; BETA-HMX; HOMOCYCLONITE; OCTOGEN; 1,3,5,7-TETRAZOCINE, OCTAHYDRO-1,3,5,7-TETRANITRO-; TETRAMETHYLENETETRANITRAMINE; CYCLOTETRAMETHYLENE TETRANITRAMINE; 1,3,5,7-TETRANITROPERHYDRO-1,3,5,7-TETRAZOCINE; CYCLOTETRAMETHYLENE TETRANITRAMINE, WET WITH NOT LESS THAN 15% WATER; C4H8N8O8; UN 0226; STCC 4901548; OHS06100

CHEMICAL FAMILY:
Amine, alicyclic

Nitro

CREATION DATE: 06/30/86 REVISION DATE: 04/04/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : CYCLOTETRAMETHYLENETETRANITRAMINE
CAS NUMBER: 2691-41-0
PERCENTAGE: <90

COMPONENT : WATER
PERCENTAGE: >15

OTHER CONTAMINANTS: NONE.

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=3  REACTIVITY=4
NFPA Ratings: Health=3 Fire=4 Reactivity=4

EMERGENCY OVERVIEW:
Colorless to white crystals.
Harmful if absorbed through skin.
May form flammable or explosive dust-air mixtures. May explode from heat, shock or friction.
Do not grind or subject to heat or shock. Keep away from heat, sparks, and flame. Avoid breathing dust. Avoid contact with eyes, skin and clothing. Avoid contamination by any source. Keep container tightly closed. Avoid creation of dust. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: No information is available.
LONG TERM EFFECTS: No information is available.
SKIN CONTACT:
SHORT TERM EFFECTS: May be harmful if absorbed.
LONG TERM EFFECTS: May cause redness and swelling of the skin and shock.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: No information is available.
INGESTION:
SHORT TERM EFFECTS: May cause drunkenness.
LONG TERM EFFECTS: No information is available.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- If vomiting occurs, keep head lower than hips to help prevent aspiration. Treat symptomatically and supportively. Get medical attention if needed.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Dangerous fire hazard when exposed to heat or flame.

Dangerous explosion hazard when exposed to heat or flame.

Dust-air mixtures may ignite or explode.

EXTINGUISHING MEDIA:
Flood with water. If no water is available use halon, dry chemical or earth. (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Do not move containers if exposure to heat has occurred. Do not fight fire when it reaches storage or cargo area. Withdraw from area and let fire burn. If possibility exists that Class A explosives are involved, evacuate to a distance of 3/4 mile for tractor/trailer load; 1 mile for a railcar load. (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 46).

Dangerously explosive. Do not fight fire in cargo area. Evacuate area and let burn.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of nitrogen.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Do not touch spilled material. No smoking, flames or flares in hazard area. Evacuate area for 2500 feet in all directions. Keep unnecessary people away.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 27 CFR Subpart K and 29 CFR 1910.109.

Consult NFPA publication 495, Explosives, Storage and Use, for proper storage and handling requirements.

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
No occupational exposure limits established by OSHA, ACGIH, or NIOSH.

VENTILATION:
Provide local exhaust or process enclosure ventilation. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators are recommended based on information found in the physical data, toxicity and health effects sections. They are ranked in order from minimum to maximum respiratory protection.
The specific respirator selected must be based on contamination levels found in the work place, must be based on the specific operation, must not exceed the working limits of the respirator and must be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

Any 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.

Any self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Colorless to white crystals.
MOLECULAR WEIGHT: 296.20
MOLECULAR FORMULA: C4-H8-N8-O8
BOILING POINT: not applicable
MELTING POINT: 527 F (275 C)
VAPOR PRESSURE: no data available
VAPOR DENSITY: not applicable
SPECIFIC GRAVITY: not available
WATER SOLUBILITY: insoluble
PH: not applicable
ODOR THRESHOLD: no data available
EVAPORATION RATE: not applicable
SOLVENT SOLUBILITY: Soluble in acetone; sparingly soluble in ether and ethanol.

DEFLAGRATION POINT (VIOLENT DECOMPOSITION): 534-549 F (279-287 C)

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
CYCLOTETRAMETHYLENETETRANITRAMINE:
Exposure to heat, friction or shock may initiate detonation.

CONDITIONS TO AVOID:
Do not allow fire to reach cargo area.

INCOMPATIBILITIES:
CYCLOTETRAMETHYLENETETRANITRAMINE:
MERCURY FULMINATE: May easily initiate an explosion.
METAL AZIDES: May initiate detonation.
OXIDIZERS (STRONG): Fire and explosion hazard.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of nitrogen.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

CYCLOTETRAMETHYLENETETRANITRAMINE:
IRRITATION DATA: 500 mg skin-rabbit mild.
TOXICITY DATA: 630 mg/kg skin-rabbit LD50; 6490 mg/kg oral-rat LD50; 300 mg/kg oral-guinea pig LD50; 1500 mg/kg oral-mouse LD50; 50 mg/kg oral-rabbit LD50; 40 mg/kg intravenous-dog LDLo; 28 mg/kg intravenous-guinea pig LD50; 25 mg/kg intravenous-rat LD50; 10 mg/kg intravenous-rabbit LD50; 2700 mg/kg unreported route-mouse LD50; 7300 mg/kg unreported route-rat LD50.
CARCINOGEN STATUS: None.
ACUTE TOXICITY LEVEL: Toxic by dermal absorption; slightly toxic by ingestion.
TARGET EFFECTS: No data available.

HEALTH EFFECTS
INHALATION:
CYCLOTETRAMETHYLENETETRANITRAMINE:
ACUTE EXPOSURE- No data available.
CHRONIC EXPOSURE- No data available.

SKIN CONTACT:
CYCLOTETRAMETHYLENETETRANITRAMINE:
TOXIC.
ACUTE EXPOSURE- The lethal dose reported in rabbits was 630 mg/kg. The symptoms were not reported.
CHRONIC EXPOSURE- Dermatitis and circulatory collapse with central nervous system disturbances have been reported in animals.

EYE CONTACT:
CYCLOTETRAMETHYLENETETRANITRAMINE:
ACUTE EXPOSURE- May cause irritation.
CHRONIC EXPOSURE- No data available.

INGESTION:
CYCLOTETRAMETHYLENETETRANITRAMINE:
ACUTE EXPOSURE- May cause narcosis.
CHRONIC EXPOSURE- No data available.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA hazardous waste numbers, D001 and D003.
100 pound CERCLA Section 103 Reportable Quantity.

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Octogen, wetted-UN 0226

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
1.1 - Explosives (with a mass explosion hazard)

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Explosive 1.1d

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: None
NON-BULK PACKAGING: 49 CFR 173.62
BULK PACKAGING: None

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: Forbidden
CARGO AIRCRAFT ONLY: Forbidden

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	N
SARA SECTION 302 (40CFR355.30):	N
SARA SECTION 304 (40CFR355.40):	N
SARA SECTION 313 (40CFR372.65):	N
OSHA PROCESS SAFETY (29CFR1910.119):	N
CALIFORNIA PROPOSITION 65:	N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	Y
REACTIVITY HAZARD:	Y
SUDDEN RELEASE HAZARD:	Y

SECTION 16

OTHER INFORMATION

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MDL Information Systems, Inc.

MSDS: DIESEL FUEL NO. 2

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 68476-34-6

SUBSTANCE: DIESEL FUEL NO. 2

TRADE NAMES/SYNONYMS:
DIESEL OIL; DIESEL FUEL; DIESEL OIL, MEDIUM; FUELS, DIESEL, NO. 2; DIESEL OIL NO. 2-D; DIESEL FUEL OIL NO. 2-D; DIESEL FUEL NO. 2-D; NO. 2 DIESEL FUEL; WINTER DIESEL; CHEVRON DIESEL FUEL NO. 2; ARCO DIESEL (ARCO PRODUCTS COMPANY); DIESEL FUEL #2; REGULAR DIESEL; FUEL OIL #2; OHS07100

CHEMICAL FAMILY:
Petroleum hydrocarbon

CREATION DATE: 03/14/85 REVISION DATE: 01/24/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : DIESEL FUEL NO. 2-D
CAS NUMBER: 68476-34-6
PERCENTAGE: >99

OTHER CONTAMINANTS: May contain trace amounts of sulfur, aniline and 2-ethylhexanol.

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=0 REACTIVITY=0
NFPA Ratings: Health=0 Fire=2 Reactivity=0

EMERGENCY OVERVIEW:
Colorless to yellow-brown liquid with a mild petroleum odor.
Causes respiratory tract and skin irritation. May affect the central nervous system.
Combustible liquid and vapor.
Keep away from all ignition sources. Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include nausea, vomiting, headache, drunkenness, disorientation, bluish skin color and coma.
LONG TERM EFFECTS: No information available on significant adverse effects.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include blisters.
LONG TERM EFFECTS: In addition to effects from short term exposure, kidney damage may occur.
EYE CONTACT:
SHORT TERM EFFECTS: May cause mild irritation.
LONG TERM EFFECTS: No information available on significant adverse effects.
INGESTION:
SHORT TERM EFFECTS: May cause nausea, vomiting, diarrhea, difficulty breathing, drunkenness and lung congestion.
LONG TERM EFFECTS: No information is available.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- Only hydrocarbons that are toxic or are solvents for toxic components need be evacuated. Extreme care must be taken to prevent

aspiration. Qualified medical personnel should consider the following: Perform gastric lavage with endotracheal intubation within 15 minutes. The following procedure may also be useful: Induce emesis with syrup of ipecac and water. When vomiting occurs, keep head lower than hips to help prevent aspiration. Do not give anything by mouth or induce vomiting if person is unconscious or otherwise unable to swallow. Treat symptomatically and supportively. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Moderate fire hazard when exposed to heat or flame.

Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.

Vapor-air mixtures are explosive above flash point.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 27).

Extinguish only if flow can be stopped; use flooding amounts of water as a fog, solid streams may be ineffective. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing vapors, keep upwind.

FLASH POINT: >125 F (>52 C)
LOWER FLAMMABLE LIMIT: >0.6%
UPPER FLAMMABLE LIMIT: >6.0%
AUTOIGNITION: >475 F (>246 C)
FLAMMABILITY CLASS(OSHA): II

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of sulfur and carbon.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Stop leak if you can do it without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area. Keep unnecessary people away; isolate hazard area and restrict entry.

WATER SPILL:
The California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) prohibits contaminating any known source of drinking water with substances known to cause cancer and/or reproductive toxicity.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 29 CFR 1910.106.

Bonding and grounding: Substances with low electroconductivity, which may be ignited by electrostatic sparks, should be stored in containers which meet the bonding and grounding guidelines specified in NFPA 77-1983, Recommended Practice on Static Electricity.

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
KEROSENE (FUEL OIL NO. 1):
100 mg/m3 (14 ppm) NIOSH recommended 10 hour TWA

Measurement method: Charcoal tube; carbon disulfide; gas chromatography with flame ionization detection; (NIOSH III # 1550, Naphthas).

MINERAL OIL MIST:
5 mg/m3 OSHA TWA
5 mg/m3 ACGIH TWA; 10 mg/m3 ACGIH STEL
(Notice of Intended Changes 1993-94)
5 mg/m3 NIOSH recommended TWA;
10 mg/m3 NIOSH recommended STEL

Measurement method: Particulate filter;
1,1,2-trichloro-1,2,2-trifluoroethane; infrared spectrometry;

(NIOSH Vol. III # 5026).

HYDROGEN SULFIDE:
20 ppm OSHA ceiling;
50 ppm OSHA 10 minute peak (once if no other measurable exposure occurs)
10 ppm (14 mg/m3) OSHA TWA (vacated by 58 FR 35338, June 30, 1993);
15 ppm (21 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
10 ppm (14 mg/m3) ACGIH TWA; 15 ppm (21 mg/m3) ACGIH STEL
10 ppm (15 mg/m3) NIOSH recommended 10 minute ceiling
10 ppm (14 mg/m3) DFG MAK TWA;
20 ppm (28 mg/m3) DFG MAK 10 minute peak, momentary value, 4 times/shift

Measurement method: Charcoal tube; ammonium hydroxide/hydrogen peroxide; ion chromatography; (NIOSH III # 6013).

500 pounds SARA Section 302 Threshold Planning Quantity
100 pounds SARA Section 304 Reportable Quantity
100 pounds CERCLA Section 103 Reportable Quantity
1500 pounds OSHA Process Safety Management Threshold Quantity

VENTILATION:
Provide local exhaust ventilation to meet published exposure limits. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Wear oil impervious clothing. Avoid prolonged or repeated contact with substance. Avoid wearing oil soaked clothing.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators are recommended based on information found in the physical data, toxicity and health effects sections. They are ranked in order from minimum to maximum respiratory protection.
The specific respirator selected must be based on contamination levels found in the work place, must be based on the specific operation, must not exceed the working limits of the respirator and must be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

Any 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.

Any self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Colorless to yellow-brown liquid with a mild petroleum odor.
BOILING POINT: 340-680 F (171-360 C)
FREEZING POINT: 0 F (-18 C)
VAPOR PRESSURE: 1 mmHg @ 20 C
VAPOR DENSITY: >1
SPECIFIC GRAVITY: 0.87-0.90
WATER SOLUBILITY: insoluble
PH: no data available
ODOR THRESHOLD: no data available
EVAPORATION RATE: no data available
VISCOSITY: 32.6-40.1 SSU @ 100 F

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
Avoid contact with heat, sparks, flames, or other sources of ignition. Vapors may be explosive. Avoid overheating of containers; containers may violently rupture in heat of fire. Avoid contamination of water sources.

Trace amounts of hydrogen sulfide may be present in this product. There is a potential for accumulation of hydrogen sulfide in the head space of containers or in enclosed areas where the product is stored, handled or used.

INCOMPATIBILITIES:
DIESEL FUEL:
  OXIDIZERS (STRONG): Fire and exposion hazard.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of sulfur and carbon.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

DIESEL FUEL:
TOXICITY DATA: >5 mL/kg skin-rabbit LD50 (marketplace sample) (AETODY); 7.5 gm/kg oral-rat LD50 (marketplace sample) (AETODY).
CARCINOGEN STATUS: Human Inadequate Evidence (IARC Group-3 for light distillate diesel fuels).
LOCAL EFFECTS: Irritant- inhalation, skin.
ACUTE TOXICITY LEVEL: Slightly toxic by dermal absorption and ingestion.
TARGET EFFECTS: Central nervous system depressant. Poisoning may also affect the liver and kidneys.
ADDITIONAL DATA: Animal studies have confirmed an association between the induction of cancer, primarily of the lung, and inhalation exposure to whole diesel exhaust. Limited epidemiologic evidence also suggests an association between occupational exposure to diesel engine emissions and lung cancer (NIOSH, 1988).

HEALTH EFFECTS
INHALATION:
DIESEL FUEL:
IRRITANT/NARCOTIC.
ACUTE EXPOSURE- Vapors or mist may cause respiratory tract irritation. A human exposure has resulted in immediate cough, dypsnea, cyanosis and unconsciousness for one hour. A productive cough with sputum smelling of diesel fuel persisted for 37 days. Chest X-rays showed diffuse shadowing, most prominent at the lung bases, which resolved slowly with treatment but was still present at day 37. High levels may also cause central nervous system excitation followed by depression with symptoms possibly including restlessness, confusion, ataxia, headache, dizziness, anorexia, nausea, vomiting, weakness, incoordination, stupor, delirium and coma.
CHRONIC EXPOSURE- Prolonged or repeated exposure may cause irritation. One individual exposed to diesel vapors in a truck cab developed nephrotoxic effects.

SKIN CONTACT:
DIESEL FUEL:
IRRITANT.
ACUTE EXPOSURE- May cause smarting, redness and irritation. A sample of diesel fuel applied to rabbits under a patch for 24 hours caused extreme irritation with severe erythema and edema with blistering and open sores.
CHRONIC EXPOSURE- Repeated or prolonged contact may cause defatting and drying of the skin resulting in irritation and dermatitis. Cutaneous hyperkeratosis has been described in engine drivers with occupational exposure to diesel fuel. Two individuals with topical exposure from washing hair or hands with diesel fuel developed acute renal failure; one also had gastrointestinal symptoms. Repeated applications to rabbit skin produced 67% mortality at 8 mL/kg. The primary causes of death were depression and anorexia which were induced by dermal irritation with infection, rather than systemic intoxication. Autopsy revealed effects on the liver and kidneys.

EYE CONTACT:
DIESEL FUEL:
ACUTE EXPOSURE- Liquid or vapor may cause slight irritation, although tests with one sample of diesel fuel in rabbit eyes was non-irritating.
CHRONIC EXPOSURE- Repeated or prolonged exposure may cause irritation.

INGESTION:
DIESEL FUEL:
NARCOTIC.
ACUTE EXPOSURE- May cause nausea, vomiting, cramping, diarrhea, and possibly symptoms of central nervous system depression. Aspiration of even small amounts during ingestion or vomiting may result in severe pulmonary irritation with coughing, gagging, dyspnea, substernal distress, and pneumonitis, pulmonary edema and hemorrhage, and death. The probable lethal dose in humans is 0.5-5 gm/kg for a 150 pound person. This amount is 1-16 ounces. Death is due to pneumonitis or respiratory failure.
CHRONIC EXPOSURE- No data available.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA Hazardous Waste Number D001.
100 pound CERCLA Section 103 Reportable Quantity.

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Diesel fuel-NA 1993

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
3 - Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG III

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101
AND SUBPART E:
None

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.203
BULK PACKAGING: 49 CFR 173.241

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 60 L
CARGO AIRCRAFT ONLY: 220 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
HYDROGEN SULFIDE		100 pounds RQ
SARA SECTION 302 (40CFR355.30):	Y	
HYDROGEN SULFIDE		500 pounds TPQ
SARA SECTION 304 (40CFR355.40):	Y	
HYDROGEN SULFIDE		100 pounds RQ
SARA SECTION 313 (40CFR372.65):	N	
OSHA PROCESS SAFETY (29CFR1910.119):	Y	
HYDROGEN SULFIDE		1500 pounds TQ
CALIFORNIA PROPOSITION 65:	Y	

*WARNING: This product contains a chemical(s) known to the state of California to cause cancer, or birth defects or other reproductive harm.

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	Y
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MSDS: GASOLINE, AUTOMOTIVE, UNLEADED

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 8006-61-9
RTECS NUMBER: LX3373000

SUBSTANCE: GASOLINE, AUTOMOTIVE, UNLEADED

TRADE NAMES/SYNONYMS:
UNLEADED GASOLINE; PREMIUM UNLEADED GASOLINE; PETROL; MOTOR SPIRITS; BENZIN; GASOLINE; "A" GRADE GASOLINE (NCRA); "N" GRADE GASOLINE (NCRA); 420003415; 600000024; UN 1203; STCC 4908178; OHS10340

CHEMICAL FAMILY:
Petroleum hydrocarbon

CREATION DATE: 04/23/85 REVISION DATE: 01/11/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : GASOLINE, AUTOMOTIVE, UNLEADED
CAS NUMBER: 8006-61-9
PERCENTAGE: 100.0
MAY CONTAIN:
BENZENE >0.1%
CAS NUMBER: 71-43-2

OTHER CONTAMINANTS: NONE

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=1  REACTIVITY=0

NFPA Ratings: Health=1 Fire=3 Reactivity=0

EMERGENCY OVERVIEW:
Clear colorless to amber, aromatic, volatile liquid
Cancer hazard (contains material which can cause cancer in humans). Risk of cancer depends on duration and level of exposure. Causes respiratory tract, skin, and eye irritation. May cause blood disorders. May affect the central nervous system.
Flammable liquid and vapor. May cause flash fire.
Do not breathe vapor or mist. Do not get in eyes, on skin, or on clothing. Keep away from all ignition sources. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include ringing in the ears, nausea, vomiting, difficulty speaking, difficulty swallowing, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, drunkenness, disorientation, numbness, twitching, visual disturbances, lung congestion, blood disorders, paralysis, convulsions, shock and coma.
LONG TERM EFFECTS: In addition to effects from short term exposure, low blood pressure, loss of memory, hearing loss, kidney damage, nerve damage and brain damage may occur. May also cause reproductive effects and cancer.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include blisters, blood in the urine, low blood pressure and kidney damage.
LONG TERM EFFECTS: In addition to effects from short term exposure, burns and tingling sensation may occur.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: In addition to effects from short term exposure, cataracts may occur.
INGESTION:
SHORT TERM EFFECTS: May cause fever, nausea, vomiting, diarrhea, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, drunkenness, disorientation, twitching, visual disturbances, bluish skin color, lung congestion, lung effects, liver damage, paralysis, convulsions, coma and heart failure.
LONG TERM EFFECTS: In addition to effects from short term exposure, impotence may occur. May also cause cancer.

CARCINOGEN STATUS:
OSHA: Y
NTP: Y
IARC: Y

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform

respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- Only hydrocarbons that are solvents for a toxic agent or are themselves toxic need to be evacuated. Extreme care must be used to prevent aspiration. Gastric lavage with a cuffed endotracheal tube in place to prevent further aspiration should be done within 15 minutes. In the absence of depression or convulsions or impaired gag reflex, emesis can also be induced using syrup of ipecac without increasing the hazard of aspiration (Dreisbach, Handbook of Poisoning, 12th Ed.). Treat symptomatically and supportively. Gastric lavage should be performed by qualified medical personnel. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Dangerous fire hazard when exposed to heat or flame.

Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.

Vapor-air mixtures are explosive.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire

(1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 27).

Extinguish only if flow can be stopped; use water in flooding amounts as fog, solid streams may spread fire. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing vapors, keep upwind. Evacuate to a radius of 1500 feet for uncontrollable fires. Consider evacuation of downwind area if material is leaking.

Water may be ineffective. (NFPA 325, Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids, 1994).

FLASH POINT: -45 F (-43 C) (CC)
LOWER FLAMMABLE LIMIT: 1.2%
UPPER FLAMMABLE LIMIT: 7.6%
AUTOIGNITION: 536-853 F (280-456 C)
FLAMMABILITY CLASS(OSHA): IB

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of carbon.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Stop leak if you can do it without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area. Keep unnecessary people away; isolate hazard area and restrict entry.

Reportable Quantity (RQ):
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity established for that substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

WATER SPILL:
The California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) prohibits contaminating any known source of drinking water with substances known to cause cancer and/or reproductive toxicity.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 29 CFR 1910.106.

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
GASOLINE (BULK HANDLING):
300 ppm (900 mg/m3) OSHA TWA (vacated by 58 FR 35338, June 30, 1993);
500 ppm (1,500 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
300 ppm (900 mg/m3) ACGIH TWA; 500 ppm (1,500 mg/m3) ACGIH STEL
ACGIH A3-Animal Carcinogen (Proposed Addition 1995-96)

BENZENE:
1 ppm OSHA TWA; 5 ppm OSHA 15 minute STEL; 0.5 ppm OSHA action level
10 ppm (30 mg/m3) ACGIH TWA;
ACGIH A2-Suspected Human Carcinogen
(Notice of Intended Changes 1994-95)
0.1 ppm (0.32 mg/m3) NIOSH recommended 8 hour TWA;
1 ppm (3.2 mg/m3) NIOSH recommended 15 minute ceiling

Measurement method: Charcoal tube; carbon disulfide; gas chromatography with flame ionization detection; (NIOSH III # 1500, Hydrocarbons, also # 3700).

10 pounds CERCLA Section 103 Reportable Quantity
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting
Subject to California Proposition 65 cancer and/or reproductive toxicity warning and release requirements- (February 27, 1987)

VENTILATION:
Provide local exhaust or general dilution ventilation to meet published exposure limits. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

Any clothing wet with a flammable liquid should be immediately removed at the location where it is wetted to prevent burns from possible ignition.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of

Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

GASOLINE:
At any detectable concentration:
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Clear colorless to amber, aromatic, volatile liquid
BOILING POINT: 100-400 F (38-204 C)
FREEZING POINT: no data available
VAPOR PRESSURE: no data available
VAPOR DENSITY: 3.0-4.0
SPECIFIC GRAVITY: 0.7-0.8
WATER SOLUBILITY: insoluble
PH: no data available
ODOR THRESHOLD: 0.25 ppm
EVAPORATION RATE: no data available
SOLVENT SOLUBILITY: Soluble in absolute alcohol, ether, chloroform, and benzene.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
Avoid contact with heat, sparks, flames, or other sources of ignition. Vapors may be explosive. Avoid overheating of containers; containers may violently rupture in heat of fire. Avoid contamination of water sources.

INCOMPATIBILITIES:
GASOLINE, AUTOMOTIVE, UNLEADED:
  OXIDIZERS (STRONG): Fire and explosion hazard.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of carbon.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

GASOLINE, AUTOMOTIVE, UNLEADED:
IRRITATION DATA: 500 ppm/1 hour eye-man moderate; 140 ppm/8 hours eye-human mild.
TOXICITY DATA: 900 ppm/1 hour inhalation-man TCLo; 300 gm/m3/5 minutes inhalation-rat LC50; 300 gm/m3/5 minutes inhalation-mouse LC50; 300 gm/m3/5 minutes inhalation-guinea pig LC50; 30000 ppm/5 minutes inhalation-mammal LCLo; 13.6 gm/kg oral-rat LD50 (AETODY); 53 mg/kg parenteral-man TDLo.
CARCINOGEN STATUS: Human Inadequate Evidence, Animal Limited Evidence (IARC Group-2B). In studies with mice and rats by inhalation, an increased incidence of hepatocellular adenomas and carcinomas was produced in female but not male mice; an increased incidence of adenomas and carcinomas of the kidney was produced in male but not female rats.
LOCAL EFFECTS: Irritant- inhalation, skin, eye.
ACUTE TOXICITY LEVEL: Slightly toxic by inhalation and ingestion.
TARGET EFFECTS: Central nervous system depressant; simple asphyxiant.
ADDITIONAL DATA: The use of alcoholic beverages enhances the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation. Toxicity and irritation data derived from unspecified and unleaded gasoline.

BENZENE:
IRRITATION DATA: 20 mg/24 hours skin-rabbit moderate; 15 mg/24 hours open skin-rabbit mild; 88 mg eye-rabbit moderate; 2 mg/24 hours eye-rabbit severe.
TOXICITY DATA: 2 pph/5 minutes inhalation-human LCLo; 65 mg/m3/5 years inhalation-human LCLo; 100 ppm inhalation-human TCLo; 150 ppm/1 year intermittent inhalation-man TCLo; 10000 ppm/7 hours inhalation-rat LC50; 300 ppm/6 hours/13 weeks intermittent inhalation-rat TCLo; 300 ppm/6 hours/99 weeks intermittent inhalation-rat TCLo; 9980 ppm inhalation-mouse LC50; 221 ppm/6 hours/7 days intermittent inhalation-mouse TCLo; 10 ppm/6 hours/10 weeks intermittent inhalation-mouse TCLo; 300 ppm/6 hours/13 weeks intermittent inhalation-mouse TCLo; 300 ppm/6 hours/16 weeks intermittent inhalation-mouse TCLo;

100 ppm/6 hours/72 weeks intermittent inhalation-mouse TCLo; 146000 mg/m3 inhalation-dog LCLo; 170000 mg/m3 inhalation-cat LCLo; 45000 ppm/30 minutes inhalation-rabbit LCLo; 20000 ppm/5 minutes inhalation-mammal LCLo; 1000 ppm/7 hours/28 weeks-intermittent inhalation-rat TCLo; 100 ppm/6 hours/3 weeks-intermittent inhalation-pig TCLo; 25 ppm/6 hours/5 days-intermittent inhalation-mouse TCLo; 500 ppm/6 hours/3 weeks-intermittent inhalation-rat TCLo; 23 mg/kg/4 hours/8 days-intermittent inhalation-rat TCLo; >9400 mg/kg skin-rabbit LD50; >9400 mg/kg skin-guinea pig LD50; 48 mg/kg skin-mouse LD50; 50 mg/kg oral-man LDLo; 6600 mg/kg/27 weeks intermittent oral-rat TDLo; 4700 mg/kg oral-mouse LD50; 930 mg/kg oral-rat LD50; 2 gm/kg oral-dog LDLo; 17 gm/kg/17 weeks-intermittent oral-rat TDLo; 4250 mg/kg/17 weeks-intermittent oral-mouse TDLo; 2197 mg/kg/5 days-intermittent subcutaneous-rat TDLo; 13536 mg/kg/12 weeks-intermittent subcutaneous-rat TDLo; 18 mg/kg/21 days-intermittent subcutaneous-rat TDLo; 5700 mg/kg oral-mammal LD50; 88 mg/kg intravenous-rabbit LDLo; 2890 ug/kg intraperitoneal-rat LD50; 340 mg/kg intraperitoneal-mouse LD50; 527 mg/kg intraperitoneal-guinea pig LDLo; 1500 mg/kg intraperitoneal-mammal LDLo; 194 mg/kg unreported-man LDLo; mutagenic data (RTECS); reproductive effects data (RTECS).

CARCINOGEN STATUS: OSHA Carcinogen; Known Human Carcinogen (NTP); Human Sufficient Evidence, Animal Sufficient Evidence (IARC Group-1). Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene.

LOCAL EFFECTS: Irritant- inhalation, skin, eye.

ACUTE TOXICITY LEVEL: Moderately toxic by ingestion; slightly toxic by inhalation and dermal absorption.

TARGET EFFECTS: Central nervous system depressant; bone marrow depressant. Poisoning may also affect the immune system and the heart.

AT INCREASED RISK FROM EXPOSURE: Persons with certain immunological tendencies, poor nutrition, anemia and drug or chemically induced agranulocytemia.

ADDITIONAL DATA: Use of alcoholic beverages may enhance the toxic effects. Use of stimulants such as epinephrine may cause cardiac arrhythmias. May cross the placenta. Interactions with medications have been reported.

HEALTH EFFECTS

INHALATION:

GASOLINE, AUTOMOTIVE, UNLEADED:

IRRITANT/NARCOTIC/ASPHYXIANT/CARCINOGEN.

ACUTE EXPOSURE- At 160-270 ppm throat irritation may occur within several hours. At 2000 ppm mild anesthesia may occur within 30 minutes. Other symptoms of central nervous system depression may include headache, nausea, vomiting, dizziness, drowsiness, facial flushing, blurred vision, slurred speech, difficulty swallowing, staggering, confusion and euphoria. At higher levels dyspnea, pulmonary edema and bronchopneumonia may develop. Further depression may occur with weak respiration and pulse, nervousness, twitching, irritability, and ataxia. Severe intoxication may result in delirium, unconsciousness, coma, and convulsions with epileptiform seizures. The pupils may be constricted or, in comatose states, fixed and dilated or unequal; nystagmus may also occur. May also affect the liver, kidneys, spleen, brain, myocardium and pancreas. Death may be due to respiratory or circulatory failure or ventricular fibrillation. Extremely high concentration may cause asphyxiation.

CHRONIC EXPOSURE- With few exceptions, most of the reported effects of repeated inhalation are from intentional "sniffing" of gasoline rather

than workplace exposure. Reported symptoms include headache, nausea, fatigue, anorexia and weight loss, pallor, dizziness, insomnia, memory loss, nervousness, confusion, muscular weakness and cramps, peripheral neuropathy, polyneuritis, and neurasthenia. It is unclear whether some of these symptoms may have been due to gasoline containing lead. Liver and and kidney damage are also possible. In a 90 day study, male but not female rats exhibited a severe, dose-related renal toxicity. In another study, an increase in renal adenomas and carcinomas in male rats and an increase in hepatocellular adenomas and carcinomas in female mice were reported.

BENZENE:
IRRITANT/NARCOTIC/BONE MARROW DEPRESSANT/CARCINOGEN.

ACUTE EXPOSURE- Concentrations of 3000 ppm may cause respiratory tract irritation; more severe exposures may result in pulmonary edema. Systemic effects are mainly on the central nervous system and depend on exposure time and concentration. No effects were noted at 25 ppm for 8 hours; signs of intoxication began at 50-150 ppm within 5 hours; at 500-1500 ppm, within 1 hour; were severe at 7500 ppm, within 30-60 minutes; and 20,000 ppm was fatal within 5-10 minutes. Effects may include nausea, vomiting, headache, dizziness, drowsiness, weakness, sometimes preceded by a brief period of exhilaration or euphoria, irritability, malaise, confusion, ataxia, staggering, weak, rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips, and tinnitus. In severe exposures there may be blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis, and coma characterized by motor restlessness, tremors and hyperreflexia, sometimes preceded by convulsions. Recovery depends on the severity of exposure. Polyneuritis may occur and there may be persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia, and agitation. Nervous irritability, breathlessness, and unsteady gait may persist for 2-3 weeks; a peculiar skin color and cardiac distress may persist for 4 weeks. Liver and kidney effects may occur, but are usually mild, temporary impairments. Chromosomal damage has been found after exposure to toxic levels. Although generally hematotoxicity is not a significant concern in acute exposure, delayed hematological effects, including anemia and thrombocytopenia, have been reported, as have petechial hemorrhages, spontaneous internal bleeding and secondary infections. In fatal exposures, death may be due to asphyxia, central nervous system depression, cardiac or respiratory failure and circulatory collapse, or occasionally, sudden ventricular fibrillation. It may occur within a few minutes to several hours, or cardiac arrythmia may occur at anytime within 24 hours. Also, death from central nervous system, respiratory or hemorrhagic complications may occur up to 5 days after exposure. Pathologic findings have included respiratory inflammation with edema and hemorrhage of the lungs, renal congestion, cerebral edema, and extensive petechial hemorrhages in the brain, pleurae, pericardium, urinary tract, mucous membranes, and skin.

CHRONIC EXPOSURE- Longterm exposure may cause symptoms referable to the central nervous, hematopoietic and immune systems. Early effects are vague and varied and may include headache, light-headedness, dizziness, nausea, anorexia, abdominal discomfort, and fatigue. Sore, dry throat, weakness, lethargy, malaise, drowsiness, nervousness, and irritability have also been reported. Later there may be dyspnea, pallor, slightly increased temperature, decreased blood pressure, rapid pulse, palpitations, and visual disturbances. Dizziness when cold water is placed in the ear and hearing impairment have been reported, as have diffuse cerebral atrophy associated with ataxia, tremors and emotional lability. Workers exposed to benzene in combination with other solvents have exhibited polyneuritis. Several case reports, one of them an acute exposure, suggest the possibility that systemic exposure may be associated with retrobulbar

or optic neuritis. Occasionally hemorrhages in retina and conjunctiva occur and rarely neuroretinal edema and papilledema have accompanied the retinal hemorrhages. Hematological effects vary widely and may appear after a few weeks or many years of exposure or even many years after exposure has ceased. The degree of exposure below which no blood effects will occur cannot be established with certainty. In the early stages, there may be blood clotting defects due to morphological, functional and quantitative platelet alteration with resultant bleeding from the nose and gums, easy bruising and petechiae; leukopenia with predominant lymphocytopenia or neutropenia; and anemia which may be normochromic or macrocytic and hypochromic. Extramedullary hematopoiesis, splenomegaly, circulating immature marrow cells, and an initial increase in leukocytes, erythrocytes and platelets have also been reported. The bone marrow may be hyper-, hypo- or normoplastic and does not always correlate with the peripheral blood picture. Also, the symptoms do not always parallel the laboratory findings. If treated at this stage, the effects appear reversible, although recovery may be protracted and there may be relapses. Decreased erythrocyte survival, hemolysis, capillary fragility, internal hemorrhages, iron metabolism disturbances, and hyperbilirubinemia have also been reported. Exposure to high levels for longer periods may result in aplasia and fatty degeneration of the bone marrow with pancytopenia. The most serious cases of aplastic anemia may be fatal due to hemorrhage and infection; death may occur within 3 months of diagnosis. Enormous variability in individual response, including non-dose dependent aplasia, and the finding of eosinophilia suggests that, in some cases, the blood dyscrasia may partially be an allergic reaction. Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene. Several studies have also suggested a link between occupational exposure and multiple myeloma and lymphoma, both Hodgkin's and nonhodgkin's. Although aplastic anemia is probably the more likely consequence of longterm exposure, it is not uncommon for an individual surviving this, to go through a preleukemic phase into frank leukemia. Conversely, leukemia without precedent aplastic anemia can occur. In one study the range of time from the start of the exposure to the diagnosis of leukemia was 3-24 years. It has been suggested that the chromosomal aberrations which can arise in peripheral blood and bone marrow cells and persist for a long time after exposure ceases, may be associated with the increased incidence of leukemia. The immunosuppressive effect has also been suggested as being associated with the leukemogenesis. Adverse effects on the immunological system have been shown to make rabbits more susceptible to tuberculosis and pneumonia and may explain why the terminal event in some cases of benzene intoxication may be overwhelming infection. Exposed mice exhibited a tendency toward induction of lymphoid neoplasms. Rats exhibited an increased incidence of neoplasms, mainly carcinomas, at various sites. Menstrual disturbances have been reported more frequently in exposed women. Testicular damage has been reported in rats, rabbits and guinea pigs. Some animal studies have demonstrated embryo/fetotoxicity, sometimes at levels as low as 10 ppm and the potential for teratogenic effects such as decreased body weight and skeletal variants, have also been shown. Other studies have not produced any abnormalities or embryolethality.

SKIN CONTACT:
GASOLINE, AUTOMOTIVE, UNLEADED:
IRRITANT.

ACUTE EXPOSURE- Liquid may cause irritation with erythema and pain. Prolonged or extensive contact may cause blistering and, in extreme cases epidermal necrolysis. A 12 year old boy partially immersed in a pool of gasoline for 1 hour experienced hypotension, abdominal tenderness, disseminated intravascular coagulation, transient hematuria, nonoliguric renal failure and an elevated serum amylase. Autopsy revealed cerebral edema, diffuse bilateral pneumonia, biventricular cardiac enlargement, toxic nephrosis, fatty infiltration of liver and peripancreatic fat necrosis.

CHRONIC EXPOSURE- Repeated or prolonged contact with the liquid may cause irritation, dermatitis and defatting of the skin with drying and cracking or burns and blistering. Some individuals may develop hypersensitivity, probably due to additives.

BENZENE:
IRRITANT.

ACUTE EXPOSURE- Direct contact may cause irritation. Effects may include erythema, a burning sensation, and with prolonged contact, blistering and edema. Under normal conditions, significant signs of systemic toxicity are unlikely from skin contact alone due to the slow rate of absorption; it may however, contribute to the toxicity from inhalation. Application to guinea pigs resulted in increased dermal permeability.

CHRONIC EXPOSURE- Repeated or prolonged contact defats the skin and may result in dermatitis with erythema, scaling, dryness, vesiculation, and fissuring, possibly accompanied by paresthesias of the fingers which may persist several weeks after the dermatitis subsides. Peripheral neuritis has also been reported. Secondary infections may occur. Tests on guinea pigs indicate sensitization is possible. Although animal studies have failed to establish a relationship between skin contact and a carcinogenic effect, most of the studies were inadequate; some papillomas and hematopoietic effects have been reported.

EYE CONTACT:
GASOLINE, AUTOMOTIVE, UNLEADED:
IRRITANT.

ACUTE EXPOSURE- Concentrations between 270 and 900 ppm may cause a sensation of irritation often before signs such as conjunctival hyperemia are visible. Liquid splashed in the eyes may cause pain, smarting and slight, transient corneal epithelial disturbance. Blepharospasm and conjunctival hyperemia and edema may occur.

CHRONIC EXPOSURE- Repeated or prolonged exposure may cause conjunctivitis and possible gradual, irreversible loss of corneal and conjunctival sensitivity.

BENZENE:
IRRITANT.

ACUTE EXPOSURE- May cause irritation. Vapor concentrations of 3000 ppm are very irritating, even on brief exposure. Droplets cause a moderate burning sensation, but only a slight, transient corneal epithelial injury with rapid recovery.

CHRONIC EXPOSURE- Repeated or prolonged exposure may cause conjunctivitis. 50% of rats exposed to 50 ppm for more than 600 hours developed cataracts.

INGESTION:
GASOLINE, AUTOMOTIVE, UNLEADED:
NARCOTIC.

ACUTE EXPOSURE- May cause irritation and burning of the gastrointestinal tract with nausea, vomiting and diarrhea. Absorption may cause initial central nervous stimulation followed by depression. Symptoms may include a mild excitation, restlessness, nervousness, irritability, twitching, weakness, blurred vision, headache, dizziness, drowsiness, incoordination,

confusion, delirium, unconsciousness, convulsions and coma. Cardiac arrythmias may occur. Transient liver damage is possible. Direct or indirect aspiration may cause chemical pneumonitis with pulmonary edema and hemorrhage, possibly complicated by bacterial pneumonia, and less frequently, by emphysema and pneumonthorax. Signs of pulmonary involvement may include coughing, dyspnea, substernal pain, sudden development of rapid breathing, cyanosis, tachycardia and fever. Even small amounts may be fatal with death caused by cardiac arrest, asphyxia or respiratory paralysis. Depending on amount aspirated, death may occur rapidly or within 24 hours.

CHRONIC EXPOSURE- No data available.

BENZENE:
NARCOTIC/CARCINOGEN.

ACUTE EXPOSURE- May cause local irritation and burning sensation in the mouth, throat and stomach, and hemorrhagic inflammatory lesions of the mucous membranes in contact with the liquid. Signs and symptoms of systemic intoxication may include nausea, vomiting, headache, dizziness, weakness, staggering, chest pain and tightness, shallow, rapid pulse and respiration, breathlessness, pallor followed by flushing, and a fear of impending death. There may be visual disturbances, tremors, convulsions, ventricullar irregularities, and paralysis. Excitement, euphoria or delirium may precede weariness, fatigue, sleepiness and followed by stupor and unconsciousness, coma and death from respiratory failure. Those who survive the central nervous system effects may develop bronchitis, pneumonia, pulmonary edema, and intrapulmonary hemorrhage. Aspiration may cause immediate pulmonary edema and hemorrhage. The usual lethal dose in humans is 10-15 milliliters, but smaller amounts have been reported to cause death. A single exposure may produce longterm effects with pancytopenia persisting up to a year.

CHRONIC EXPOSURE- Daily administration to humans of 2-5 grams in olive oil caused headache, vertigo, bladder irritability, impotence, gastric disturbances, and evidence of renal congestion. In female rats treated with 132 single daily doses over 187 days, no effects were observed at 1 mg/kg; slight leukopenia at 10 mg/kg; and both leukopenia and anemia at 50 and 100 mg/kg. Oral administration to rats and mice at various dose levels induced neoplasms at multiple sites in males and females. In a one year gavage study, rats given 50 or 250 mg/kg, 4-5 days/week for 52 weeks did not exhibit acute or subacute toxic effects, but a dose correlated increase of leukemias and mammary carcinomas was observed; some other tumor types were also reported. Reproductive effects have been reported in animals.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA Hazardous Waste Number D001.
100 pound CERCLA Section 103 Reportable Quantity.

Benzene - Regulatory level: 0.5 mg/l (TCLP-40 CFR 261 Appendix II)
materials which contain the above substance at or above the TCLP regulatory level meet the EPA toxicity characteristic, and must be disposed of in accordance with 40 CFR part 262. EPA Hazardous Waste Number D018.

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Gasoline-UN 1203

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
3 - Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 5 L
CARGO AIRCRAFT ONLY: 60 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4): Y

BENZENE 10 pounds RQ

SARA SECTION 302 (40CFR355.30): N
SARA SECTION 304 (40CFR355.40): N
SARA SECTION 313 (40CFR372.65): Y
BENZENE
OSHA PROCESS SAFETY (29CFR1910.119): N
CALIFORNIA PROPOSITION 65: Y
BENZENE

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)
ACUTE HAZARD: Y
CHRONIC HAZARD: Y
FIRE HAZARD: Y
REACTIVITY HAZARD: N
SUDDEN RELEASE HAZARD: N

SECTION 16

OTHER INFORMATION

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MDL Information Systems, Inc.

MSDS: HYDROCHLORIC ACID

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
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SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 7647-01-0

SUBSTANCE: HYDROCHLORIC ACID

TRADE NAMES/SYNONYMS:
HYDROCHLORIC ACID 2 N; HYDROCHLORIC ACID 1 N; HYDROCHLORIC ACID 0.5 N; HYDROCHLORIC ACID 0.2 N; HYDROCHLORIC ACID 0.1 N; HYDROCHLORIC ACID 0.02 N; HYDROCHLORIC ACID SOLUTIONS; UN 1789; OHS40067

CHEMICAL FAMILY:
Inorganic acid

CREATION DATE: 07/09/85 REVISION DATE: 03/05/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : HYDROCHLORIC ACID
CAS NUMBER: 7647-01-0
PERCENTAGE: 0.07-7.29

COMPONENT : WATER
PERCENTAGE: 92.71-99.9

OTHER CONTAMINANTS: None.

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=3 REACTIVITY=0
NFPA Ratings: Health=3 Fire=0 Reactivity=0

EMERGENCY OVERVIEW:
Colorless liquid.
Causes respiratory tract, skin, and eye burns and severe burns to mucous membranes.
Do not breathe vapor or mist. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation, possibly severe. Additional effects may include headache, lung congestion and lung effects.
LONG TERM EFFECTS: May cause effects as in short term exposure. Additional effects may include digestive disorders.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause burns.
LONG TERM EFFECTS: Same effects as short term exposure.
EYE CONTACT:
SHORT TERM EFFECTS: May cause burns.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: May cause burns.
LONG TERM EFFECTS: Same effects as short term exposure.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Maintain airway, blood pressure and respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). If burns occur, proceed with the following: Cover affected area securely with sterile, dry, loose-fitting dressing. Treat symptomatically and supportively. Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Continue irrigating with normal saline until the pH has returned to normal (30-60 minutes). Cover with sterile bandages. Get medical attention immediately.

INGESTION:

FIRST AID- Do not use gastric lavage or emesis. Give large amounts of water or milk. Repeat if vomiting occurs. Ingested corrosive should be diluted approximately 100 times to render it harmless to tissues. (Dreisbach & Robertson; Handbook of Poisoning; 12th Ed.). Do not give anything by mouth to a person who is unconscious or otherwise unable to swallow. If vomiting occurs, keep head lower than hips to help prevent aspiration. Maintain airway and respiration. Treat symptomatically and supportively. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Negligible fire hazard when exposed to heat or flame.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 60).

Extinguish using agents indicated; do not use water directly on material. If large amounts of combustible materials are involved, use water spray or fog in flooding amounts. Use water spray to absorb corrosive vapors. Cool containers with flooding amounts of water from as far a distance as possible. Avoid breathing corrosive vapors; keep upwind.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition may release corrosive hydrogen chloride.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Do not touch spilled material. Stop leak if you can do it without risk. For

small spills, take up with sand or other absorbent material and place into containers for later disposal. For small dry spills, with clean shovel place material into clean, dry container and cover. Move containers from spill area. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry.

Reportable Quantity (RQ): 5000 pounds
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Protect against physical damage. Store in cool, well-ventilated place, separated from all oxidizing materials (NFPA 49, Hazardous Chemicals Data, 1975).

Threshold Planning Quantity (TPQ):
The Superfund Amendments and Reauthorization Act (SARA) Section 302 requires that each facility where any extremely hazardous substance is present in a quantity equal to or greater than the TPQ established for that substance notify the state emergency response commission for the state in which it is located. Section 303 of SARA requires these facilities to participate in local emergency response planning (40 CFR 355.30).

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
5 ppm (7.6 mg/m3) OSHA ceiling
5 ppm (7.6 mg/m3) ACGIH ceiling
5 ppm (7.6 mg/m3) NIOSH recommended ceiling
5 ppm (7.6 mg/m3) DFG MAK TWA;
10 ppm (15.2 mg/m3) DFG MAK 5 minute peak, momentary value, 8 times/shift

Measurement method: Silica gel tube; sodium bicarbonate/sodium carbonate; ion chromatography; (NIOSH Vol. III # 7903, Inorganic Acids).

500 pounds SARA Section 302 Threshold Planning Quantity (gas)
5000 pound SARA Section 304 Reportable Quantity (gas)
5000 pounds CERCLA Section 103 Reportable Quantity (liquid)

5000 pounds OSHA Process Safety Management Threshold Quantity (gas)
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting

VENTILATION:
Provide local exhaust ventilation system to meet published exposure limits.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

Emergency wash facilities:
Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent any possibility of skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
50 ppm- Any chemical cartridge respirator with cartridge(s) providing protection against this compound.
Any air-purfiying, full-facepiece respirator (gas mask) with a chin-style, front-, or back- mounted canister providing protection against this compound.
Any powered, air-purfiying respirator with cartridge(s) providing protection against this compound.
Any supplied-air respirator.
Any self-contained breathing apparatus with a full facepiece.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Colorless liquid.
BOILING POINT: 212 F (100 C)
FREEZING POINT: 32 F (0 C)
VAPOR PRESSURE: 14 mmHg @ 20 C (H2O)
VAPOR DENSITY: 0.7 (H2O)
SPECIFIC GRAVITY: 1.0 - 1.2
WATER SOLUBILITY: complete
PH: <2
ODOR THRESHOLD: no data available
EVAPORATION RATE: (ether=1) >1

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Reacts exothermically with water or steam to produce toxic and corrosive fumes.

CONDITIONS TO AVOID:
May burn but does not ignite readily. Flammable, poisonous gases may accumulate in tanks and hopper cars. May ignite combustibles (wood, paper, oil, etc.).

INCOMPATIBILITIES:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
ACETIC ANHYDRIDE: Violent reaction.
ALCOHOLIC HYDROGEN CYANIDE: Explosive reaction.
ALUMINUM: Explosion.
ALUMINUM-TITANIUM ALLOYS: Ignites or incandesces when heated.
2-AMINOETHANOL: Violent reaction.
AMMONIUM HYDROXIDE: Violent reaction.
BASES: Violent reaction.
BRASS: Corrodes.
BRONZE: Corrodes.
CALCIUM CARBIDE: Reacts with incandescence.
CALCIUM HYPOCHLORITE: Ignition.
CESIUM ACETYLIDE: Ignites on contact.
CHLORINE + DINITROANILINES: Vigorous reaction with release of flammable hydrogen gas fumes.
CHLOROSULFONIC ACID: Violent reaction.
1,1-DIFLUOROETHYLENE: Extremely exothermic decomposition reaction.
DOWICIL 100: Decomposes.
ETHYLENE DIAMINE: Violent reaction.
ETHYLENE IMINE: Violent reaction.
FLUORINE: Ignites on contact.
HEXALITHIUM DISILICIDE: Incandesces.
IRON: Corrodes with evolution of flammable hydrogen gas.
MAGNESIUM BORIDE: Produces a spontaneously flammable gas.
MERCURIC SULFATE: Violent reaction at 125 C.
METAL ACETYLIDES: Violent reaction.
METALS: Severe corrosion with evolution of flammable hydrogen gas.

OLEUM: Violent reaction.
OXIDIZERS (STRONG): Violent reaction.
OXYGEN + PLATINUM: Ignites on contact.
PERCHLORIC ACID: Violent reaction.
PLASTICS, RUBBER, COATINGS: Attacks.
POTASSIUM PERMANGANATE: Explosion hazard.
BETA-PROPIOLACTONE: Violent reaction.
PROPYLENE OXIDE: Violent reaction.
RUBIDIUM ACETYLIDE: Ignites on contact.
SILICA (GEL): Incompatible.
SODIUM: Vigorous or explosive reaction.
SULFURIC ACID: Explosive reaction with release of toxic hydrogen chloride gas.
TETRASELENIUM TETRANITRIDE: Explodes on contact.
VINYL ACETATE: Violent reaction.

HAZARDOUS DECOMPOSITION:
Thermal decomposition may release corrosive hydrogen chloride.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
IRRITATION DATA:
ANHYDROUS: 100 mg/30 seconds rinsed eye-rabbit mild.
HYDROCHLORIC ACID: 5 mg/30 seconds rinsed eye-rabbit mild.
TOXICITY DATA:
HYDROGEN CHLORIDE (ANHYDROUS GAS): 4701 ppm/30 minutes inhalation-rat LC50; 2644 ppm/30 minutes inhalation-mouse LC50.
MONOHYDRATE: No data available.
DIHYDRATE: No data available.
TRIHYDRATE: No data available.
HEXAHYDRATE: No data available.
HYDROGEN CHLORIDE (AEROSOL): 5666 ppm/30 minutes inhalation-rat LC50; 2142 ppm/30 minutes inhalation-mouse LC50.
HYDROCHLORIC ACID: 1300 ppm/30 minutes inhalation-human LCLo; 3000 ppm/5 minutes inhalation-human LCLo; 3124 ppm/1 hour inhalation-rat LC50; 1108 ppm/1 hour inhalation-mouse LC50; 4413 ppm/30 minutes inhalation-rabbit LCLo; 4413 ppm/30 minutes inhalation-guinea pig LCLo; 685 ug/m3/24 hours/84 days-continuous inhalation-rat TCLo; 900 mg/kg oral-rabbit LD50; 1449 mg/kg intraperitoneal-mouse LD50; 81 mg/kg unreported-man LDLo; mutagenic data (RTECS); reproductive effects data (RTECS).
CARCINOGEN STATUS: Human Inadequate Evidence, Animal Inadequate Evidence (IARC Group-3).
LOCAL EFFECTS: Corrosive- inhalation, skin, eye, ingestion.
ACUTE TOXICITY LEVEL: Moderately toxic by inhalation and ingestion.
TARGET EFFECTS: No data available.

HEALTH EFFECTS
INHALATION:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

CORROSIVE. 100 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- Inhalation of fumes at levels of 5-35 ppm may cause irritation and burning of the throat, coughing and choking; 50-100 ppm may be barely tolerable for 1 hour. High levels may cause inflammation and occasionally ulceration of the nose, throat or larynx, bronchitis, pneumonia, palpitations and headache. Higher concentrations may cause necrosis of the tracheal and bronchial epithelium, nasoseptal perforation, atelectasis, emphysema, damage to pulmonary blood vessels and lesions of the liver and other organs. Death may be due to laryngeal spasm, bronchopneumonia or pulmonary edema. 1300-2000 ppm may be dangerous, even on brief exposures. Reproductive effects have been reported in animals.
CHRONIC EXPOSURE- Repeated or prolonged exposure may cause erosion and discoloration of exposed teeth, chronic bronchitis and gastritis.

SKIN CONTACT:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE.
ACUTE EXPOSURE- Contact may cause severe irritation, inflammation, ulceration, necrosis and chemical burns. Shock symptoms may develop including rapid pulse, sweating and collapse. Photosensitization reactions may occur in persons previously exposed.
CHRONIC EXPOSURE- Repeated or prolonged contact with vapors or dilute solutions may cause dermatitis. Photosensitization may occur.

EYE CONTACT:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE.
ACUTE EXPOSURE- Contact may cause severe irritation, conjunctivitis, corneal necrosis and burns with impairment or permanent loss of vision. A drop of hydrochloric acid splashed in the eye and immediately washed out has produced a white coagulation of the corneal and conjunctival epithelium. Animals exposed to vapor concentrations of 1350 ppm for one and a half hours showed clouding of the cornea and 300 ppm for 6 hours showed slight erosion of the corneal epithelium.
CHRONIC EXPOSURE- Animals exposed to vapor at 100 ppm for 6 hours daily for 50 days showed only slight unrest and irritation of the eyes, but no ocular injury. Effects are dependent upon concentration and duration of exposure. Conjunctivitis or effects similar to those for acute exposure may occur.

INGESTION:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE.
ACUTE EXPOSURE- Ingestion of the acid may cause burns of the mouth, throat, esophagus and stomach with consequent pain, uneasiness, nausea, salivation, vomiting, diarrhea, chills, shock and intense thirst. Nephritis, fever and perforation of the intestinal tract, and circulatory collapse may occur. Death may be due to esophageal or gastric necrosis.
CHRONIC EXPOSURE- No data available.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA Hazardous Waste Number D002.
100 pound CERCLA Section 103 Reportable Quantity.

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Hydrochloric acid, solution-UN 1789

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
8 - Corrosive material

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Corrosive

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.154
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 1 L
CARGO AIRCRAFT ONLY: 30 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
HYDROGEN CHLORIDE (HYDROCHLORIC ACID)		5000 pounds RQ
SARA SECTION 302 (40CFR355.30):	Y	
HYDROGEN CHLORIDE (HYDROCHLORIC ACID)		500 pounds TPQ
SARA SECTION 304 (40CFR355.40):	Y	
HYDROGEN CHLORIDE (HYDROCHLORIC ACID)		5000 pounds RQ
SARA SECTION 313 (40CFR372.65):	Y	
HYDROGEN CHLORIDE (HYDROCHLORIC ACID)		
OSHA PROCESS SAFETY (29CFR1910.119):	Y	
HYDROGEN CHLORIDE (HYDROCHLORIC ACID)		5000 pounds TQ
CALIFORNIA PROPOSITION 65:	N	

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MDL Information Systems, Inc.

MSDS: HYDRODESULFURIZED KEROSINE

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

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1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 64742-81-0
RTECS NUMBER: OA5510000

SUBSTANCE: HYDRODESULFURIZED KEROSINE

TRADE NAMES/SYNONYMS:
KEROSINE (PETROLEUM), HYDRODESULFURIZED; KEROSINE (TYPE 1-K);
SHELL SOLVENT 139; SHELL(R) 2-K KEROSENE - MARKED;
SHELL(R) 1-K KEROSENE - MARKED; HYDRODESULFURIZED KEROSINE (PETROLEUM);
HYDRODESULFURIZED KEROSINE C9-C16; DIESEL 1 LOW SULPHUR CLEAR;
DIESEL 1 LOW SUPHUR COLOURED; OHS62332

CHEMICAL FAMILY:
Petroleum hydrocarbon

CREATION DATE: 01/10/95 REVISION DATE: 08/22/95

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : HYDRODESULFURIZED KEROSINE (C9-C16)
CAS NUMBER: 64742-81-0
PERCENTAGE: 100.0

OTHER CONTAMINANTS: MAY CONTAIN LESS THAN 0.04% SULFUR

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=1 REACTIVITY=0
NFPA Ratings: Health=1 Fire=2 Reactivity=0

EMERGENCY OVERVIEW:
Clear, colorless to red liquid with a kerosene odor.
Causes skin irritation. May affect the central nervous system.
Combustible liquid and vapor.
Keep away from all ignition sources. Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include nausea, headache, drunkenness and coma.
LONG TERM EFFECTS: No information available on significant adverse effects.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: In addition to effects from short term exposure, burns may occur.
EYE CONTACT:
SHORT TERM EFFECTS: No information available on significant adverse effects.
LONG TERM EFFECTS: No information is available.
INGESTION:
SHORT TERM EFFECTS: May cause vomiting, digestive disorders, headache, drowsiness, drunkenness, twitching, blurred vision, lung congestion, convulsions and coma.
LONG TERM EFFECTS: No information is available.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- Only hydrocarbons that are toxic or are solvents for toxic components need be evacuated. Extreme care must be taken to prevent aspiration. Qualified medical personnel should consider the following: Perform gastric lavage with endotracheal intubation within 15 minutes.

The following procedure may also be useful: Induce emesis with syrup of ipecac and water. When vomiting occurs, keep head lower than hips to help prevent aspiration. Do not give anything by mouth or induce vomiting if person is unconscious or otherwise unable to swallow. Treat symptomatically and supportively. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Moderate fire hazard when exposed to heat or flame.

Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.

Vapor-air mixtures are explosive above flash point.

May be ignited by static electricity.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 27).

Extinguish only if flow can be stopped; use flooding amounts of water as a fog, solid streams may be ineffective. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing vapors, keep upwind.

FLASH POINT: >100 F (>38 C)
LOWER FLAMMABLE LIMIT: 0.7%
UPPER FLAMMABLE LIMIT: 5.0%
AUTOIGNITION: 444 F (229 C) (estimated)
FLAMMABILITY CLASS(OSHA): II

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of carbon.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Stop leak if you can do it without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area. Keep unnecessary people away; isolate hazard area and restrict entry.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 29 CFR 1910.106.

Bonding and grounding: Substances with low electroconductivity, which may be ignited by electrostatic sparks, should be stored in containers which meet the bonding and grounding guidelines specified in NFPA 77-1983, Recommended Practice on Static Electricity.

Store in cool, dry, well-ventilated area. Keep container tightly closed.

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
HYDRODESULFURIZED KEROSINE:
  See information on kerosene.

KEROSENE (FUEL OIL NO. 1):
  100 mg/m3 (14 ppm) NIOSH recommended 10 hour TWA

  Measurement method: Charcoal tube; carbon disulfide; gas chromatography with flame ionization detection; (NIOSH III # 1550, Naphthas).

VENTILATION:
Provide local exhaust or general dilution ventilation to meet published exposure limits. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

KEROSENE:
1000 ppm- Any chemical cartridge respirator with organic vapor cartridge(s).
Any supplied-air respirator.

2500 ppm- Any supplied-air respirator operated in a continuous-flow mode.
Any powered, air-purifying respirator with organic vapor cartidge(s).

5000 ppm- Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).
Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front-, or back-mounted organic vapor canister.
Any powered, air-purifying respirator with a tight-fitting facepiece and organic vapor cartridge(s).
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front-, or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Clear, colorless to red liquid with a kerosene odor.
BOILING POINT: 302-554 F (150-290 C)
FREEZING POINT: no data available
VAPOR PRESSURE: 2.0 mmHg @ 20 C
VAPOR DENSITY: 5-6
SPECIFIC GRAVITY: 0.79-0.82
WATER SOLUBILITY: insoluble
VOLATILITY: 100%
PH: no data available
ODOR THRESHOLD: no data available
EVAPORATION RATE: 600x slower (ethyl ether=1)
VISCOSITY: 1.3 cst @ 40 C

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
Avoid contact with heat, sparks, flames, or other sources of ignition. Vapors may be explosive. Avoid overheating of containers; containers may violently rupture in heat of fire. Avoid contamination of water sources.

INCOMPATIBILITIES:
HYDRODESULFURIZED KEROSINE:
  ACIDS: Incompatible.
  OXIDIZERS (STRONG): Fire and explosion hazard.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of carbon.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

HYDRODESULFURIZED KEROSINE:
IRRITATION DATA: 500 mg/24 hours skin-rabbit moderate.
TOXICITY DATA: >5 gm/m3/4 hours inhalation-rat LC50 (Sunoco & Shell MSDS's); >2 gm/kg skin-rabbit LD50 (Sunoco & Shell MSDS's); >5 gm/kg oral-rat LD50 (Sunoco & Shell MSDS's).
CARCINOGEN STATUS: Human Inadequate Evidence (IARC Group-3 for distillate (light) fuel oils), Animal Limited Evidence (IARC Group-3 for straight-run kerosene).
LOCAL EFFECTS: Irritant- skin.
ACUTE TOXICITY LEVEL: Moderately toxic by inhalation; slightly toxic by dermal absorption and ingestion.
TARGET EFFECTS: Central nervous system depressant.

AT INCREASED RISK FROM EXPOSURE: Persons with disorders or diseases of the skin, eye, nervous, respiratory and /or pulmonary systems.

HEALTH EFFECTS
INHALATION:
HYDRODESULFURIZED KEROSINE:
NARCOTIC.
ACUTE EXPOSURE- May cause irritation of the nose and throat. Prolonged exposure to high vapor concentrations may cause headache, dizziness, nausea and central nervous system depression with possible unconsciousness, respiratory failure and coma.
CHRONIC EXPOSURE- High concentrations may cause degenerative changes in the liver, kidneys, and bone marrow.

SKIN CONTACT:
HYDRODESULFURIZED KEROSINE:
IRRITANT.
ACUTE EXPOSURE- May cause moderate irritation. A Draize skin irritation score of 4.0 out of 10.0 has been reported. Skin absorption may occur.
CHRONIC EXPOSURE- May cause defatting, drying and dermatitis. Prolonged immersion in the liquid may cause chemical burns. A study with mice produced acanthosis, hyperkeratosis and skin tumors.

EYE CONTACT:
HYDRODESULFURIZED KEROSINE:
ACUTE EXPOSURE- May cause minor irritation and smarting. An irritation score of 0.3 out of 110.0 at 24 hours has been reported.
CHRONIC EXPOSURE- No data available.

INGESTION:
HYDRODESULFURIZED KEROSINE:
NARCOTIC.
ACUTE EXPOSURE- May cause gastrointestinal disturbances with irritation, nausea, vomiting and diarrhea. May also cause central nervous system depression with excitation, euphoria, headache, dizziness, drowsiness, blurred vision, fatigue, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death. Aspiration into the lungs can cause chemical pneumonitis with pulmonary edema and hemorrhaging.
CHRONIC EXPOSURE- No data available.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA Hazardous Waste Number D001.
100 pound CERCLA Section 103 Reportable Quantity.

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Kerosene-UN 1223

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
3 - Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG III

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.203
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 60 L
CARGO AIRCRAFT ONLY: 220 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	N
SARA SECTION 302 (40CFR355.30):	N
SARA SECTION 304 (40CFR355.40):	N
SARA SECTION 313 (40CFR372.65):	N
OSHA PROCESS SAFETY (29CFR1910.119):	N
CALIFORNIA PROPOSITION 65:	N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	Y
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MDL Information Systems, Inc.

MSDS: LEAD

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 7439-92-1
RTECS NUMBER: OF7525000

SUBSTANCE: LEAD

TRADE NAMES/SYNONYMS:
C.I. PIGMENT METAL 4; C.I. 77575; LEAD FLAKE; KS-4; LEAD S 2; SI; SO; PLUMBUM; S0; PB-S 100; LEAD ELEMENT; L-18; L-24; L-29; L-27; T-134; 40BP, 80BP, 100BP, 200BP, FP, SFP (SCM METAL PRODUCTS INC); LEAD GRANULES; PB; OHS12510

CHEMICAL FAMILY:
Metal

CREATION DATE: 12/10/84 REVISION DATE: 04/03/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : LEAD
CAS NUMBER: 7439-92-1
PERCENTAGE: 99.8

OTHER CONTAMINANTS: BISMUTH, COPPER, ARSENIC, ANTIMONY, TIN, IRON, SILVER, ZINC

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=1  REACTIVITY=0
NFPA Ratings: Health=1 Fire=0 Reactivity=0

EMERGENCY OVERVIEW:
Bluish-white, silvery gray, heavy, malleable metal
Suspect cancer hazard (contains material which can cause cancer in animals). Risk of cancer depends on duration and level of contact. May cause birth defects in humans. May damage nerves and the kidneys.
May form flammable or explosive dust-air mixtures.
Avoid breathing dust. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Avoid creation of dust. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include metal fume fever, yellowing of the skin and eyes, blood in the urine, disorientation, tingling sensation, loss of memory, paralysis, effects on the brain and shock. May also cause reproductive effects.
LONG TERM EFFECTS: In addition to effects from short term exposure, black lines on the gums, high blood pressure, twitching, visual disturbances, impotence, sterility, kidney damage, nerve damage and coma may occur. May also cause reproductive effects.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: Same effects as short term exposure.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: May cause effects as reported in short term inhalation. May also cause reproductive effects.
LONG TERM EFFECTS: May cause effects as reported in long term inhalation.
ADDITIONAL DATA: May cause cancer.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: Y

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- Do not induce vomiting. Do not give anything by mouth to a person who is unconscious or otherwise unable to swallow. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider performing gastric lavage or catharsis. Activated charcoal is useful.

NOTE TO PHYSICIAN
ANTIDOTE:
The following antidote has been recommended. However, the decision as to whether the severity of poisoning requires administration of any antidote and actual dose required should be made by qualified medical personnel.

FOR LEAD POISONING:
Initiate urine flow first. Give 10% dextrose in water intravenously, 10-20 mL/kg body weight, over a period of 1-2 hours. If urine flow does not start, give mannitol, 20% solution, 5-10 mL/kg body weight intravenously over 20 minutes. Fluid must be limited to requirements and cathertization may be necessary in coma. Daily urine output should be 350-500 mL/m2/24 hours. Excessive fluids further increase cerebral edema.
For adults with acute encephalopathy, give dimercaprol, 4 mg/kg, intramuscularly every 4 hours for 30 doses. Beginning 4 hours later, give calcium disodium edetate at a seperate injection site, 12.5 mg/kg intramuscularly every 4 hours as a 20% solution, with 0.5% procaine added, for a total of 30 doses. If significant improvement has not occurred by the fourth day, increase the number of injections by 10 for each drug.
For symptomatic adults, the course of dimercaprol and calcium disodium edetate can be shortened or calcium disodium edetate only can be given in a dosage of 50 mg/kg intravenously as 0.5% solution in 5% dextrose in water or normal saline by infusion over not less than 8 hours for not more than 5 days. Follow with penicillamine, 500-750 mg/day, orally for 1-2 months or until urine lead levels drops below 0.3 mg/24 hours (Dreisbach, Handbook of Poisoning, 12th Ed.). Antidote should be administered by qualified medical personnel.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Negligible fire hazard in bulk form; however, dust, powder, or fumes are flammable or explosive when exposed to heat or flames.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 53).

Extinguish using agent suitable for type of surrounding fire. Avoid breathing vapors and dusts. Keep upwind.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may release toxic oxides of lead.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Do not touch spilled material. Stop leak if you can do it without risk. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For small dry spills, with a clean shovel place material into clean, dry container and cover. Move containers from spill area. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry.

Residue should be cleaned up using a high-efficiency particulate filter vacuum.

Reportable Quantity (RQ): 1 pound
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

WATER SPILL:
The California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) prohibits contaminating any known source of drinking water with substances known to cause cancer and/or reproductive toxicity.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in a cool, dry place.

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
LEAD, INORGANIC FUMES AND DUST (as Pb):
50 ug/m3 OSHA 8 hour TWA
30 ug/m3 OSHA 8 hour action level
If an employee is exposed to lead for more than 8 hours per day the following formula is used:
Maximum permissible limit (in ug/m3)= 400 divided by hours worked in the day
0.05 mg/m3 ACGIH TWA
ACGIH A3-Animal Carcinogen
0.10 mg/m3 NIOSH recommended 10 hour TWA
0.1 mg/m3 DFG MAK TWA;
1.0 mg/m3 DFG MAK 30 minute peak, average value, 1 time/shift

Measurement Method: Particulate filter; nitric acid/hydrogen peroxide; atomic absorption spectrometry; (NIOSH III # 7082, also # 7105).

10 pound CERCLA Section 103 Reportable Quantity
(Reporting not required for release of solid metal particles with a diameter greater than or equal to 100 micrometers (0.004 inches))
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting
Subject to California Proposition 65 cancer and/or reproductive toxicity warning and release requirments- (February 27, 1987)

VENTILATION:
Provide local exhaust ventilation system to meet published exposure limits.

Lead (elemental, inorganic, and soaps):
Ventilation should meet the requirements in 29 CFR 1910.1025(e).

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

LEAD (ELEMENTAL, INORGANIC, AND SOAPS):
Protective eye equipment should meet the requirements for protective work clothing and equipment in 29 CFR 1910.1025(g).

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

LEAD (ELEMENTAL, INORGANIC, AND SOAPS):
Protective clothing should meet the requirements for protective work clothing and equipment in 29 CFR 1910.1025(g).

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

LEAD (ELEMENTAL, INORGANIC & SOAPS):
Protective gloves should meet the requirements for protective work clothing and equipment in 29 CFR 1910.1025(g).

RESPIRATOR:

The following respirators are the minimum legal requirements as set forth by the Occupational Safety and Health Administration found in 29 CFR 1910, Subpart Z.

RESPIRATORY PROTECTION FOR LEAD AEROSOLS

Airborne concentration of lead or condition of use	Required respirator
Not in excess of 0.5 mg/m3 (10x PEL)	Half-mask, air purifying respirator equipped with high-efficiency filters.
Not in excess of 2.5 mg/m3 (50x PEL)	Full facepiece, air-purifying respirator with high efficiency filters.
Not in excess of 50 mg/m3 (1000x PEL)	Any powered air-purifying respirator with high efficiency filters; or Half-mask supplied-air respirator operated in positive-pressure mode.
Not in excess of 100 mg/m3	Supplied-air respirators with full facepiece, hood or helmet or suit, operated in positive pressure mode.
Greater than 100 mg/m3, unknown concentrations or firefighting	Full facepiece, self-contained breathing apparatus operated in positive-pressure mode.

(Respirators specified for higher concentrations can be used at lower concentrations of lead).
(Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.)
(A high efficiency particulate filter means 99.97% efficient against 0.3 micron particles.)

The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH pocket guide to chemical hazards, or NIOSH criteria documents.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

LEAD, INORGANIC FUMES AND DUSTS (as Pb):

0.50 mg/m3- Any air-purifying respirator with a high-efficiency particulate filter.
Any supplied-air respirator.

1.25 mg/m3- Any supplied-air respirator operated in a continuous-flow mode.
Any powered, air-purifying respirator with a high-efficiency particulate filter.

2.5 mg/m3- Any air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter.
Any supplied-air respirator that has a tight-fitting facepiece

and is operated in a continuous-flow mode.
Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter.
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.

50 mg/m3- Any supplied-air respirator operated in a pressure-demand or other positive pressure mode.

100 mg/m3- Any supplied-air respirator that has a full facepiece and operated in a pressure-demand or other positive pressure mode.

Escape- Any air-purifying, full facepiece respirator with a high-efficiency particulate filter.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Bluish-white, silvery gray, heavy, malleable metal
MOLECULAR WEIGHT: 207.19
MOLECULAR FORMULA: PB
BOILING POINT: 3164 F (1740 C)
MELTING POINT: 622 F (328 C)
VAPOR PRESSURE: 1.3 mmHg @ 970 C
VAPOR DENSITY: not applicable
SPECIFIC GRAVITY: 11.3
WATER SOLUBILITY: insoluble
PH: not applicable
ODOR THRESHOLD: no data available
EVAPORATION RATE: not applicable
SOLVENT SOLUBILITY: Soluble in nitric acid, hot concentrated sulfuric acid

HARDNESS (MOHS): 1.5

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
May burn but does not ignite readily. Prevent dispersion of dust in air. Do not allow spilled material to contaminate water sources.

INCOMPATIBILITIES:
LEAD:
AMMONIUM NITRATE: Violent or explosive reaction.
CHLORINE TRIFLUORIDE: Violent reaction.
DISODIUM ACETYLIDE: Trituration in mortar may be violent and liberate carbon.
HYDROGEN PEROXIDE (52% OR GREATER): Violent decomposition.
HYDROGEN PEROXIDE (60% SOLUTION) + TRIOXANE: Spontaneously detonable.
METALS (ACTIVE): Incompatible.
NITRIC ACID: Lead-containing rubber may ignite.
OXIDIZERS (STRONG): Incompatible.
SODIUM AZIDE: Forms lead azide and copper azide in copper pipe.
SODIUM CARBIDE: Vigorous reaction.
SULFURIC ACID (HOT): Reacts.
ZIRCONIUM-LEAD ALLOYS: Ignition on impact.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may release toxic oxides of lead.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

LEAD:
TOXICITY DATA: 10 ug/m3 inhalation-human TCLo; 450 mg/kg/6 years oral-woman TDLo; 1050 ug/kg/30 weeks-intermittent oral-rat TDLo; 6879 mg/kg/5 weeks-continuous oral-mouse TDLo; 1 gm/kg intraperitoneal-rat LDLo; mutagenic data (RTECS); reproductive effects data (RTECS).
CARCINOGEN STATUS: Human Inadequate Evidence, Animal Sufficient Evidence (IARC Group-2B for inorganic lead compounds). Renal tumors were produced in animals by lead acetate, subacetate and phosphate given orally, subcutaneously or intraperitoneally. No evaluation could be made of the carcinogenicity of powdered lead.
ACUTE TOXICITY LEVEL: Insufficient data.
TARGET EFFECTS: Neurotoxin; nephrotoxin; teratogen. Poisoning may also affect the blood, heart, and the endocrine and immune systems.
AT INCREASED RISK FROM EXPOSURE: Persons with pre-existing nervous system or gastrointestinal disorders, anemia, or chronic bronchitis.
ADDITIONAL DATA: May cross the placenta. Smoking may result in high blood lead levels.

HEALTH EFFECTS
INHALATION:
LEAD:
100 mg(Pb)/m3 Immediately Dangerous to Life or Health.
See information on lead compounds and metal fume fever.

LEAD COMPOUNDS:

NEUROTOXIN/NEPHROTOXIN/TERATOGEN.
100 mg(Pb)/m3 Immediately Dangerous to Life or Health.

ACUTE EXPOSURE- Absorption of large amounts of lead may cause a metallic taste, thirst, a burning sensation in the mouth and throat, salivation, abdominal pain with severe colic, vomiting, diarrhea of black or bloody stools, constipation, fatigue, sleep disturbances, dullness, restlessness, irritability, memory loss, loss of concentration, delirium, oliguria often with hematuria and albuminuria, encephalopathy with visual failure, paresthesias, muscle pain and weakness, convulsions, and paralysis. Death may result from cardiorespiratory arrest or shock. Survivors of acute exposure may experience the onset of chronic intoxication. Liver effects may include enlargement and tenderness, and jaundice. The fatal dose of absorbed lead is approximately 0.5 grams. Pathological findings include gastrointestinal inflammation and renal tubular degeneration.

CHRONIC EXPOSURE- Prolonged or repeated exposure to low levels of lead may result in an accumulation in body tissues and exert adverse effects on the blood, nervous systems, heart, endocrine and immune systems, kidneys, and reproduction. Early stages of lead poisoning, "plumbism", may be evidenced by anorexia, weight loss, constipation, apathy or irritability, occasional vomiting, fatigue, headache, weakness, metallic taste in the mouth, gingival lead line in persons with poor dental hygiene, and anemia. Loss of recently developed motor skills is generally observed only in children. More advanced stages of poisoning may be characterized by intermittent vomiting, irritability and nervousness, myalgia of the arms, legs, joints and abdomen, paralysis of the extensor muscles of the arms and legs with wrist and/or foot drop. Severe "plumbism" may result in persistent vomiting, ataxia, periods of stupor or lethargy, encephalopathy with visual disturbances which may progress to optic neuritis and atrophy, hypertension, papilledema, cranial nerve paralysis, delirium, convulsions, and coma. Neurologic sequelae may include mental retardation, seizures, cerebral palsy, and dystonia musculorum deformans. Irreversible kidney damage has been associated with industrial exposure. Reproductive effects have been exhibited in both males and females. Paternal effects may include decreased sex drive, impotence, sterility and adverse effects on the sperm which may increase the risk of birth defects. Maternal effects may include miscarriage and stillbirths in exposed women or women whose husbands were exposed, abortion, sterility or decreased fertility, and abnormal menstrual cycles. Lead crosses the placenta and may affect the fetus causing birth defects, mental retardation, behavioral disorders, and death during the first year of childhood. Animal studies indicate that reproductive effects may be additive if both parents are exposed to lead.

METAL FUME FEVER:

ACUTE EXPOSURE- Metal fume fever, an influenza-like illness, may occur due to the inhalation of freshly formed metal oxide particles sized below 1.5 microns and usually between 0.02-0.05 microns. Symptoms may be delayed 4-12 hours and begin with a sudden onset of thirst, and a sweet, metallic or foul taste in the mouth. Other symptoms may include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalized feeling of malaise. Fever, chills, muscular pain, mild to severe headache, nausea, occasional vomiting, exaggerated mental activity, profuse sweating, excessive urination, diarrhea and prostration may also occur. Tolerance to fumes develops rapidly, but is quickly lost. All symptoms usually subside within 24-36 hours.

CHRONIC EXPOSURE- There is no form of chronic metal fume fever, however, repeated bouts with symptoms as described above are quite common. Resistance to the condition develops after a few days of exposure, but is quickly lost in 1 or 2 days.

SKIN CONTACT:

LEAD:
See information on lead compounds.

LEAD COMPOUNDS:
ACUTE EXPOSURE- Contact with lead powders or dust may be irritating. Lead is not absorbed through the skin, but may be transferred to the mouth inadvertently by cigarettes, chewing tobacco, food, or make-up.
CHRONIC EXPOSURE- Prolonged or repeated exposure to the powder or dust may result in dermatitis. Systemic toxicity may develop if lead is transferred to the mouth by cigarettes, chewing tobacco, food, or make-up.

EYE CONTACT:
LEAD:
See information on lead compounds.

LEAD COMPOUNDS:
ACUTE EXPOSURE- Lead dust or powders may be irritating. Metallic lead particles may cause an inflammatory foreign body reaction and injury is generally thought to be mechanical and not toxic.
CHRONIC EXPOSURE- Prolonged exposure may cause conjunctivitis.

INGESTION:
LEAD:
See information on lead compounds.

LEAD COMPOUNDS:
NEUROTOXIN/NEPHROTOXIN/TERATOGEN.
ACUTE EXPOSURE- Absorption of large amounts of lead from the intestinal tract may cause all the same effects as detailed in acute inhalation. The fatal dose of absorbed lead is approximately 0.5 grams.
CHRONIC EXPOSURE- Prolonged or repeated exposure to low levels of lead may result in an accumulation in body tissues and adverse effects on the kidneys, heart and blood and on the nervous, reproductive, endocrine and immune systems as detailed in chronic inhalation.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Lead - Regulatory level: 5.0 mg/L (TCLP-40 CFR 261 Appendix II)
materials which contain the above substance at or above the TCLP regulatory level meet the EPA toxicity characteristic, and must be disposed of in accordance with 40 CFR part 262. EPA Hazardous Waste Number D008.

SECTION 14

TRANSPORT INFORMATION

No classification currently assigned

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
LEAD, INORGANIC FUMES AND DUST (as Pb)		10 pounds RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
LEAD, INORGANIC FUMES AND DUST (as Pb)		
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	Y	
LEAD, INORGANIC FUMES AND DUST (as Pb)		

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MSDS: NITRIC ACID

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 7697-37-2
RTECS NUMBER: QU5775000

SUBSTANCE: NITRIC ACID

TRADE NAMES/SYNONYMS:
AQUA FORTIS; WFNA; RFNA; HYDROGEN NITRATE; AZOTIC ACID; NITRYL HYDROXIDE; NITAL; AQUAFORTIS HYDROGEN NITRATE (EM SCIENCE); UN 2031; STCC 4918528; HNO3; OHS16550

CHEMICAL FAMILY:
Inorganic acid

CREATION DATE: 12/04/84 REVISION DATE: 03/04/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : NITRIC ACID
CAS NUMBER: 7697-37-2
PERCENTAGE: 70

COMPONENT : WATER
PERCENTAGE: 30

OTHER CONTAMINANTS: NONE

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=3  REACTIVITY=0
NFPA Ratings: Health=3 Fire=0 Reactivity=0

EMERGENCY OVERVIEW:
Colorless to pale yellow liquid with a suffocating odor.
May be fatal if inhaled. Causes respiratory tract, skin, and eye burns and severe burns to mucous membranes.
May ignite combustibles.
Poison. Do not breathe vapor or mist. Do not get in eyes, on skin, or on clothing. Store away from combustible materials. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May be fatal if inhaled. May cause burns.
LONG TERM EFFECTS: Same effects as short term exposure.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause burns.
LONG TERM EFFECTS: Same effects as short term exposure.
EYE CONTACT:
SHORT TERM EFFECTS: May cause burns.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: May cause burns.
LONG TERM EFFECTS: Same effects as short term exposure.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Maintain airway, blood pressure and respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). If burns occur, proceed with the following: Cover affected area securely with sterile, dry, loose-fitting dressing. Treat symptomatically and supportively. Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Continue irrigating with normal saline until the pH

medical attention immediately.

INGESTION:
FIRST AID- Do not use gastric lavage or emesis. Give large amounts of water or milk. Repeat if vomiting occurs. Ingested corrosive should be diluted approximately 100 times to render it harmless to tissues. (Dreisbach & Robertson; Handbook of Poisoning; 12th Ed.). Do not give anything by mouth to a person who is unconscious or otherwise unable to swallow. If vomiting occurs, keep head lower than hips to help prevent aspiration. Maintain airway and respiration. Treat symptomatically and supportively. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Negligible fire hazard when exposed to heat or flame.

Oxidizer: Oxidizers decompose, especially when heated, to yield oxygen or other gases which will increase the burning rate of combustible matter. Contact with easily oxidizable, organic, or other combustible materials may result in ignition, violent combustion or explosion.

EXTINGUISHING MEDIA:
Water, dry chemical or soda ash
(1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, flood area with water from a distance
(1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 44).

Use flooding amounts of water as fog. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing corrosive vapors, keep upwind. Consider evacuation of downwind area if material is leaking.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of nitrogen.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Keep combustibles (wood, paper, oil, etc.) Away from spilled material. Do not touch spilled material. Stop leak if you can do it without risk. Use water spray to reduce vapors. Do not get water inside container. For small spills, flush area with flooding amounts of water. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry. Ventilate closed spaces before entering.

Reportable Quantity (RQ): 1000 pounds
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SOIL SPILL:
Dig a holding area such as a pit, pond or lagoon to contain spill and dike surface flow using barrier of soil, sandbags, foamed polyurethane or foamed concrete. Absorb liquid mass with fly ash or cement powder.

Neutralize spill with slaked lime, sodium bicarbonate or crushed limestone.

AIR SPILL:
Apply water spray to knock down and reduce vapors. Knock-down water is corrosive and toxic and should be diked for containment and later disposal.

WATER SPILL:
Add suitable agent to neutralize spilled material to pH-7.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Protect against physical damage. Separate from metallic powders, carbides, hydrogen sulfide, turpentine, organic acids, and all combustible, organic or other readily oxidizable materials. Provide good ventilation and avoid direct sunlight (NFPA 49, Hazardous Chemicals Data, 1975).

Store away from incompatible substances.

Threshold Planning Quantity (TPQ):
The Superfund Amendments and Reauthorization Act (SARA) Section 302 requires that each facility where any extremely hazardous substance is present in a quantity equal to or greater than the TPQ established for that substance notify the state emergency response commission for the state in which it is located. Section 303 of SARA requires these facilities to participate in local

emergency response planning (40 CFR 355.30).

Threshold quantity (TQ): 500 pounds
The Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard requires that facilities utilizing a process which involves a chemical at or above its specified threshold quantity comply with the provisions of 29 CFR 1910.119, Process Safety Management of highly hazardous chemicals.

Consult NFPA publication 43A, Storage of Liquid and Solid Oxidizing Materials, for Storage Requirements.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
NITRIC ACID:
2 ppm (5 mg/m3) OSHA TWA;
4 ppm (10 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
2 ppm (5 mg/m3) ACGIH TWA; 4 ppm (10 mg/m3) ACGIH STEL
2 ppm (5 mg/m3) NIOSH recommended TWA;
4 ppm (10 mg/m3) NIOSH recommended STEL
10 ppm (25 mg/m3) DFG MAK TWA;
20 ppm (50 mg/m3) DFG MAK 5 minute peak, momentary value, 8 times/shift

Measurement method: Silica gel tube; sodium bicarbonate/sodium carbonate; ion chromatography; (NIOSH Vol. III # 7903, Inorganic Acids).

1000 pounds SARA Section 302 Threshold Planning Quantity
1000 pounds SARA Section 304 Reportable Quantity
1000 pounds CERCLA Section 103 Reportable Quantity
500 pounds OSHA Process Safety Management Threshold Quantity
(94.5% by weight or greater)
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting

VENTILATION:
Process enclosure recommended to meet published exposure limits.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

Emergency wash facilities:
Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent any possibility of skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:

The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

NITRIC ACID:
25 ppm- Any supplied-air respirator operated in a continuous-flow mode.
Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against this compound. Only nonoxidizable sorbents are allowed (not chracoal).
Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against this compound. Only nonoxidizable sorbents are allowed (not charcoal).
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against this compound. Only nonoxidizable sorbents are allowed (not charcoal).
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Colorless to pale yellow liquid with a suffocating odor.
MOLECULAR WEIGHT: 63.01
MOLECULAR FORMULA: H-N-O3
BOILING POINT: 181 F (83 C)
FREEZING POINT: -44 F (-42 C)
VAPOR PRESSURE: 47.9 mmHg @ 20 C
VAPOR DENSITY: 3.2
SPECIFIC GRAVITY: 1.5027 @ 25 C
WATER SOLUBILITY: very soluble
PH: no data available
ODOR THRESHOLD: no data available
EVAPORATION RATE: not available
SOLVENT SOLUBILITY: Soluble in ether.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
NITRIC-15N ACID:
Reacts exothermically with water.

CONDITIONS TO AVOID:
May ignite other combustible materials (wood, paper, oil, etc.). Reacts violently with water and fuels. Flammable, poisonous gases may accumulate in tanks and hopper cars. Runoff to sewer may create fire or explosion hazard.

INCOMPATIBILITIES:
NITRIC ACID:
ACETIC ACID: May react explosively.
ACETIC ANHYDRIDE: Explosive reaction by friction or impact.
ACETONE: May react explosively.
ACETONITRILE: Explosive mixture.
4-ACETOXY-3-METHOXYBENZALDEHYDE: Exothermic reaction.
ACROLEIN: Temperature and pressure increase in closed container.
ACRYLONITRILE: Explosive reaction at 90 C.
ACRYLONITRILE-METHACRYLATE COPOLYMER: Incompatible.
ALCOHOLS: Possible violent reaction or explosion; formation of explosive compound in the presence of heavy metals.
ALKANETHIOLS: Exothermic reaction with possible ignition.
2-ALKOXY-1,3-DITHIA-2-PHOSPHOLANE: Ignition reaction.
ALLYL ALCOHOL: Temperature and pressure increase in closed container.
ALLYL CHLORIDE: Temperature and pressure increase in closed container.
AMINES (ALIPHATIC OR AROMATIC): Possible ignition reaction.
2-AMINOETHANOL: Temperature and pressure increase in closed container.
2-AMINOTHIAZOLE: Explosive reaction.
AMMONIA (GAS): Burns in an atmosphere of nitric acid vapor.
AMMONIUM HYDROXIDE: Temperature and pressure increase in closed container.
AMMONIUM NITRATE: Forms explosive mixture.
ANILINE: Ignites on contact.
ANILINIUM NITRATE: Forms explosive solution.
ANION EXCHANGE RESINS: Possible violent exothermic reaction.
ANTIMONY: Violent reaction.
ARSINE: Explosive reaction.
ARSINE-BORON TRIBROMIDE: Violent oxidation.
BASES: Reacts.
BENZENE: Explosive reaction.
BENZIDINE: Spontaneous ignition.
BENZONITRILE: Possible explosion.
BENZOTHIOPHENE DERIVATIVES: Formation of possibly explosive compounds.
N-BENZYL-N-ETHYLANILINE: Vigorous decomposition.
1,4-BIS(METHOXYMETHYL)2,3,5,6-TETRAMETHYLBENZENE: Gas evolution.
BISMUTH: Intense exothermic reaction or explosion.
1,3-BIS(TRIFLUOROMETHYL)BENZENE: Possible explosion.
BORON: Violent reaction with incandescence.
BORON DECAHYDRIDE: Explosive reaction.
BORON PHOSPHIDE: Ignition reaction.
BROMINE PENTAFLUORIDE: Ignition reaction.
N-BUTYL MERCAPTAN: Ignition reaction.
N-BUTYRALDEHYDE: Temperature and pressure increase in closed container.
CADMIUM PHOSPHIDE: Explosive reaction.
CALCIUM HYPOPHOSPHITE: Ignition reaction.
CARBON (PULVERIZED): Violent reaction.

CELLULOSE: Forms easily combustible ester.
CHLORATES: Reacts.
CHLORINE: Incompatible.
CHLORINE TRIFLUORIDE: Violent reaction.
CHLOROBENZENE: Possible explosion.
4-CHLORO-2-NITROANILINE: Forms explosive compound.
CHLOROSULFONIC ACID: Temperature and pressure increase in closed container.
COAL: Explosive mixture.
COATINGS: Attacks.
CRESOL: Temperature and pressure increase in closed container.
CROTONALDEHYDE: Violent decomposition with ignition.
CUMENE: Temperature and pressure increase in closed container.
CUPRIC NITRIDE: Explosive reaction.
CUPROUS NITRIDE: Violent reaction.
CYANATES: Possible explosive reaction.
CYCLOHEXANONE: Violent reaction.
CYCLOHEXYLAMINE: Forms explosive compound.
CYCLOPENTADIENE: Explosive reaction.
1,2-DIAMINOETHANEBIS(TRIMETHYLGOLD): Explosive reaction.
DIBORANE: Spontaneous ignition.
DI-2-BUTOXYETHYL ETHER: Violent decomposition reaction.
2,6-DI-T-BUTYL PHENOL: Formation of explosive compound.
DICHLOROETHANE: Forms shock and heat sensitive mixture.
DICHLOROETHYLENE: Forms explosive compound.
DICHLOROMETHANE: Forms explosive solution.
DICYCLOPENTADIENE: Spontaneous ignition.
DIENES: Ignition reaction.
DIETHYLAMINO ETHANOL: Possible explosion.
DIETHYL ETHER: Possible explosion.
3,6-DIHYDRO-1,2,2H-OXAZINE: Explosive interaction.
DIISOPROPYL ETHER: Temperature and pressure increase in closed container.
DIMETHYLAMINOMETHYLFERROCENE: Violent decomposition if heated.
DIMETHYL ETHER: Forms explosive compound.
DIMETHYL HYDRAZINE: Ignites on contact.
DIMETHYL SULFOXIDE + 1,4-DIOXANE: Explosion.
DIMETHYL SULFOXIDE + <14% WATER: Explosive reaction.
DINITROBENZENE: Explosion hazard.
DINITROTOLUENE: Explosive reaction.
DIOXANE + PERCHLORIC ACID: Possible explosion.
DIPHENYL DISTIBENE: Explosive oxidation.
DIPHENYL MERCURY + CARBON DISULFIDE: Violent reaction.
DIPHENYL TIN: Ignition reaction.
DISODIUM PHENYL ORTHOPHOSPHATE: Violent explosion.
DIVINYL ETHER: Possible ignition reaction.
EPICHLOROHYDRIN: Temperature and pressure increase in closed container.
ETHANESULFONAMIDE: Explosive reaction.
ETHOXY-ETHYLENE DITHIOPHOSPHATE: Ignition on contact.
M-ETHYL ANILINE: Ignition reaction.
ETHYLENE DIAMINE: Temperature and pressure increase in closed container.
ETHYLENE GLYCOL: Forms shock and heat sensitive mixture.
ETHYLENEIMINE: Temperature and pressure increase in closed container.
5-ETHYL-2-METHYL PYRIDINE: Explosive reaction.
ETHYL PHOSPHINE: Ignition reaction.
5-ETHYL-2-PICOLINE: Forms explosive compounds.
FERROUS OXIDE (POWDERED): Intense exothermic reaction.
FLUORINE: Possible explosive reaction.
FORMIC ACID: Exothermic reaction with release of toxic gases.
2-FORMYLAMINO-1-PHENYL-1,3-PROPANEDIOL: Possible explosion.
FUEL OIL (BURNING): Explosion.
FULMINATES: Reacts.
FURFURYLIDENE KETONES: Ignites on contact.

TRIS(IODOMERCURI)PHOSPHINE: Violent decomposition.
TRITHIOACETONE: Explosive reaction.
TURPENTINE: Explosive mixture.
UNSYMMETRICAL DIMETHYL HYDRAZINE: Spontaneous ignition.
URANIUM: Explosive reaction.
URANIUM ALLOY: Violent reaction.
URANIUM DISULFIDE: Violent reaction.
URANIUM-NEODYMIUM ALLOYS: Explosive reaction.
VINYL ACETATE: Temperature and pressure increase in closed container.
VINYLIDENE CHLORIDE: Temperature and pressure increase in closed container.
WOOD: Possible ignition.
P-XYLENE: Intense reaction in presence of sulfuric acid.
ZINC: Incandescent reaction.
ZINC ETHOXIDE: Possible explosion.
ZIRCONIUM-URANIUM ALLOYS: Explosive reaction.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of nitrogen.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

NITRIC ACID:
TOXICITY DATA:
ANHYDROUS: 49 ppm/4 hours inhalation-rat LC50 (Van Water & Rogers, Inc MSDS); 2500 ppm/1 hour inhalation-rat LC50 (Dupont MSDS); 1071 ug/m3/24 hours/84 days-continuous inhalation-rat TCLo; 430 mg/kg oral-human LDLo; 50-500 mg/kg oral-unspecified species LD50 (Dupont MSDS); 110 mg/kg unreported-man LDLo; reproductive effects data (RTECS).
MONOHYDRATE: No data available.
TRIHYDRATE: No data available.
CARCINOGEN STATUS: None.
LOCAL EFFECTS: Corrosive- inhalation, skin, eyes, ingestion.
ACUTE TOXICITY LEVEL: Highly toxic by inhalation.
TARGET EFFECTS: No data available.
AT INCREASED RISK FROM EXPOSURE: Persons with impaired pulmonary function, pre-existing eye and skin disorders.

HEALTH EFFECTS
INHALATION:
NITRIC ACID:
CORROSIVE/HIGHLY TOXIC. 100 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- Inhalation of acidic substances may cause severe respiratory irritation with coughing, choking, and possibly yellowish burns of the mucous membranes. Other initial symptoms may include dizziness, headache, nausea, and weakness. Pulmonary edema may be immediate in the most severe exposures, but more likely will occur after a latent period of 5-72 hours. The symptoms may include tightness in the chest, dyspnea, dizziness, frothy sputum, and cyanosis. Physical findings may include hypotension, weak, rapid pulse, moist rales, and hemoconcentration. In non-fatal cases, complete recovery may occur within a few days or weeks or, convalescence may be prolonged with frequent relapses and continued dyspnea and other

signs and symptoms of pulmonary insufficiency. In severe exposures, death due to anoxia may occur within a few hours after onset of the symptoms of pulmonary edema or following a relapse.

CHRONIC EXPOSURE- Depending on the concentration and duration of exposure, repeated or prolonged exposure to an acidic substance may cause erosion of the teeth, inflammatory and ulcerative changes in the mouth, and possibly jaw necrosis. Bronchial irritation with cough and frequent attacks of bronchial pneumonia may occur. Gastrointestinal disturbances are also possible.

SKIN CONTACT:
NITRIC ACID:
CORROSIVE.

ACUTE EXPOSURE- Direct contact with liquid or vapor may cause severe pain, burns and possibly yellowish stains. Burns may be deep with sharp edges and heal slowly with scar tissue formation. Dilute solutions of nitric acid may produce mild irritation and harden the epidermis without destroying it. Concentrated acid solutions applied to over 25% of the skin area in rats produced elevated methemoglobin and blood nitrate levels.

CHRONIC EXPOSURE- Effects depend on the concentration and duration of exposure. Repeated or prolonged contact with acidic substances may result in dermatitis or effects similar to acute exposure.

EYE CONTACT:
NITRIC ACID:
CORROSIVE.

ACUTE EXPOSURE- Direct contact with acidic substances may cause pain and lacrimation, photophobia, and burns, possibly severe. The degree of injury depends on the concentration and duration of contact. In mild burns, the epithelium regenerates rapidly and the eye recovers completely. In severe cases, the extent of injury may not be fully apparent for several weeks. Ultimately, the whole cornea may become deeply vascularized and opaque resulting in blindness. In the worst cases, the eye may be totally destroyed. Concentrated nitric acid may impart a yellow color to the eye upon contact.

CHRONIC EXPOSURE- Effects depend on the concentration and duration of exposure. Repeated or prolonged exposure to acidic substances may cause conjunctivitis or effects as in acute exposure.

INGESTION:
NITRIC ACID:
CORROSIVE.

ACUTE EXPOSURE- Acidic substances may cause circumoral burns with yellow discoloration and corrosion of the mucous membranes of the mouth, throat and esophagus. There may be immediate pain and difficulty or inability to swallow or speak. Epiglottal edema may result in respiratory distress and possibly asphyxia. Marked thirst, epigastric pain, nausea, vomiting and diarrhea may occur. Depending on the degree of espohageal and gastric corrosion, the vomitus may contain fresh or dark precipitated blood and large shreds of mucosa. Shock with marked hypotension, weak, rapid pulse, shallow respiration, and clammy skin may occur. Circulatory collapse may ensue and if uncorrected, lead to renal failure. In severe cases, gastric, and to a lesser degree, esophageal perforation and subsequent peritonitis may occur and be accompanied by fever and abdominal rigidity. Esophageal, gastric anc pyloric stricture may occur within a few weeks, but may be delayed for months or even years. Death may result within a short time from asphyxia, circulatory collapse or aspiration of even minute amounts. Later death may be due to peritonitis, severe nephritis or pneumonia. Coma and convulsions sometimes occur terminally.

CHRONIC EXPOSURE- Depending on the concentration, repeated ingestion of

GERMANIUM: Violent reaction.
GLYCEROL: Possible explosion.
GLYOXAL: Temperature and pressure increase in closed container.
HEXALITHIUM DISILICIDE: Explosive reaction.
HEXAMETHYLBENZENE: Possible explosion.
2,2,4,4,6,6-HEXAMETHYLTRITHIANE: Explosive oxidation.
HEXENAL: Explodes on heating.
HYDRAZINE: Violent reaction.
HYDRAZOIC ACID: Energetic reaction.
HYDROGEN IODIDE: Ignition reaction.
HYDROGEN PEROXIDE: Forms unstable mixture.
HYDROGEN PEROXIDE AND KETONES: Forms explosive products.
HYDROGEN PEROXIDE AND MERCURIC OXIDE: Forms explosive compounds.
HYDROGEN PEROXIDE AND THIOUREA: Forms explosive compounds.
HYDROGEN SELENIDE: Ignition reaction.
HYDROGEN SULFIDE: Incandescent reaction.
HYDROGEN TELLURIDE: Ignition and possible explosive reaction.
INDANE AND SULFURIC ACID: Explosive reaction.
ISOPRENE: Temperature and pressure increase in closed container.
KETONES (CYCLIC): Violent reaction.
LACTIC ACID + HYDROFLUORIC ACID: Explosive reaction.
LITHIUM: Ignition reaction.
LITHIUM SILICIDE: Incandescent reaction.
MAGNESIUM: Explosive reaction.
MAGNESIUM + 2-NITROANILINE: May ignite on contact.
MAGNESIUM PHOSPHIDE: Incandescent reaction.
MAGNESIUM SILICIDE: Violent reaction.
MAGNESIUM-TITANIUM ALLOY: Forms shock and heat sensitive mixture.
MANGANESE (POWDERED): Incandescence and possible explosion.
MESITYL OXIDE: Temperature and pressure increase in closed container.
MESITYLENE: Possible explosive reaction.
METALS: Violent reaction with explosion or ignition.
METAL ACETYLIDES: Violent or explosive reaction.
METAL CARBIDES: Violent or explosive reaction.
METAL CYANIDES: Explosive reactions.
METAL FERRICYANIDE OR FERROCYANIDE: Violent reaction.
METAL SALICYLATES: Forms explosive compounds.
METAL THIOCYANATES: Possible explosion.
2-METHYLBENZIMIDAZOLE + SULFURIC ACID: Possible explosive reaction.
4-METHYLCYCLOHEXANONE: Explosive reaction.
2-METHYL-5-ETHYLPYRIDINE: Temperature and pressure increase in closed container.
METHYL THIOPHENE: Ignition reaction.
NEODYMIUM PHOSPHIDE: Violent reaction.
NICKEL TETRAPHOSPHIDE: Ignition reaction.
NITRO AROMATIC HYDROCARBONS: Forms highly explosive products.
NITROBENZENE: Explosive reaction, especially in the presence of water.
NITROMETHANE: Explosive reaction.
NITRONAPHTHALENE: Explosion hazard.
NON-METAL OXIDES : Explosive reaction.
OLEUM: Temperature and pressure increase in closed container.
ORGANIC MATERIALS: Fire and explosion hazard.
ORGANIC SUBSTANCES: Possible explosion.
PERCHLORATES: Possible explosion.
PHENYL ACETYLENE + 1,1-DIMETHYLHYDRAZINE: Violent reaction.
PHENYL ORTHOPHOSPHORIC ACID DISODIUM SALT: Forms explosive products.
PHOSPHINE + OXYGEN: Spontaneous ignition.
PHOSPHONIUM IODIDE: Ignition reaction.
PHOSPHORUS (VAPOR): Ignites when heated.
PHOSPHOROUS HALIDES: Ignition reaction.
PHOSPHORUS TETRAIODIDE: Vigorous reaction.

PHOSPHORUS TRICHLORIDE: Explosive reaction.
PHTHALIC ACID: Possible explosive reaction.
PHTHALIC ANHYDRIDE: Exothermic reaction and forms explosive products.
PICRATES: Reacts.
PLASTICS: Attacks.
POLYALKENES: Intense reaction.
POLYDIBROMOSILANES: Explosive reaction.
POLY(ETHYLENE OXIDE) DERIVATIVES: Possible explosion.
POLYPROPYLENE: Temperature and pressure increase in a closed container.
POLY(SILYLENE): Ignition.
POLYURETHANE (FOAM): Vigorous reaction.
POTASSIUM HYPOPHOSPHITE: Explosive reaction.
POTASSIUM PHOSPHINATE: Explodes on evaporation.
B-PROPIOLACTONE: Temperature and pressure increase in closed container.
PROPIOPHENONE + SULFURIC ACID: Exothermic reaction above -5 C.
PROPYLENE GLYCOL + HYDROFLUORIC ACID + SILVER NITRATE: Explosive mixture.
PROPYLENE OXIDE: Temperature and pressure increase in closed container.
PYRIDINE: Temperature and pressure increase in closed container.
PYROCATECHOL: Ignites on contact.
REDUCING AGENTS: Possible explosive or ignition reaction.
RESORCINOL: Possible explosion.
RUBBER: Vigorous reaction, possible explosion.
SELENIUM: Vigorous reaction.
SELENIUM HYDRIDE: Ignition or incandescent reaction.
SELENIUM IODOPHOSPHIDE: Explosive reaction.
SILICON: Violent reaction.
SILICONE OIL: Possible explosion.
SILVER BUTEN-3-YNIDE: Explosion.
SODIUM: Spontaneous ignition.
SODIUM AZIDE: Exothermic reaction.
SODIUM HYDROXIDE: Temperature and pressure increase in a closed container.
STIBINE: Explosive reaction.
SUCROSE (SOLID): Vigorous reaction.
SULFAMIC ACID: Violent reaction with evolution of toxic nitrous oxide.
SULFIDES: Reacts.
SULFUR DIOXIDE: Explosive reaction.
SULFUR HALIDES: Violent reaction.
SULFURIC ACID: Possible explosion.
SULFURIC ACID + GLYCERIDES: Explosive reaction.
SULFURIC ACID + TEREPHTHALIC ACID: Violent reaction.
SURFACTANTS + PHOSPHORIC ACID: Explosion hazard.
TERPENES: Spontaneous ignition.
TETRABORANE: Explosive reaction.
TETRABORANE DECAHYDRIDE: Explosive reaction.
TETRAPHOSPHOROUS DIIODOTRISELENIDE: Explosive reaction.
TETRAPHOSPHOROUS IODIDE: Ignites on contact.
TETRAPHOSPHOROUS TETRAOXIDE TRISULFIDE: Violent reaction.
THIOALDEHYDES: Violent reaction.
THIOKETONES: Violent reaction.
THIOPHENES: Explosive reaction.
TITANIUM: Forms shock-sensitive compound.
TITANIUM ALLOYS: Possible explosive reaction.
TITANIUM-MAGNESIUM ALLOY: Possible explosion on impact.
TOLUENE: Violent reaction.
TOLUIDENE: Ignition reaction.
1,3,5-TRIACETYLHEXAHYDRO-1,3,5-TRIAZINE + TRIFLUOROACETIC ANHYDRIDE:
Explosive reaction.
TRIAZINE: Violently explosive reaction.
TRICADMIUM DIPHOSPHIDE: Explosive reaction.
TRIETHYLGALLIUM MONOETHYL ETHER COMPLEX: Ignition reaction.
TRIMETHYLTRIOXANE: Intense reaction.

acidic substances may result in inflammatory and ulcerative changes in the mucous membranes of the mouth and other effects as in acute ingestion. Reproductive effects have been reported in animals.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA hazardous waste numbers D001 and D002.
100 pound CERCLA Section 103 Reportable Quantity.

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Nitric acid-UN 2031

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
8 - Corrosive material

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG I

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Corrosive

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: None
NON-BULK PACKAGING: 49 CFR 173.158

BULK PACKAGING: 49 CFR 173.243

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: Forbidden
CARGO AIRCRAFT ONLY: 2.5 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
NITRIC ACID		1000 pounds RQ
SARA SECTION 302 (40CFR355.30):	Y	
NITRIC ACID		1000 pounds TPQ
SARA SECTION 304 (40CFR355.40):	Y	
NITRIC ACID		1000 pounds RQ
SARA SECTION 313 (40CFR372.65):	Y	
NITRIC ACID		
OSHA PROCESS SAFETY (29CFR1910.119):	Y	
NITRIC ACID		500 pounds TQ
CALIFORNIA PROPOSITION 65:	N	

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	Y
REACTIVITY HAZARD:	Y
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MDL Information Systems, Inc.

MSDS: TETRACHLOROETHYLENE

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
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FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 127-18-4
RTECS NUMBER: KX3850000

SUBSTANCE: TETRACHLOROETHYLENE

TRADE NAMES/SYNONYMS:
ETHENE, TETRACHLORO-; ETHYLENE, TETRACHLORO-; ANKILOSTIN; DIDAKEN; NEMA; ETHYLENE TETRACHLORIDE; PERCHLOROETHYLENE; PERC; PERCHLOROETHENE; PERCLENE; 1,1,2,2-TETRACHLOROETHYLENE; TETRACAP; TETRACHLOROETHENE; PCE; RCRA U210; NCI-C04580; ENT 1,860; STCC 4940355; UN 1897; C2CL4; OHS22900

CHEMICAL FAMILY:
Halogen compound, aliphatic

CREATION DATE: 10/25/84 REVISION DATE: 03/04/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : TETRACHLOROETHYLENE
CAS NUMBER: 127-18-4
PERCENTAGE: 100.0

OTHER CONTAMINANTS: NONE

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2  REACTIVITY=0
NFPA Ratings: Health=2 Fire=0 Reactivity=0

EMERGENCY OVERVIEW:

Clear, colorless, volatile liquid with a mild ether-like odor.
Suspect cancer hazard (contains material which can cause cancer in animals). Risk of cancer depends on duration and level of contact. Causes respiratory tract, skin, and eye irritation. May affect the central nervous system. Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include metallic taste, yellowing of the skin and eyes, ringing in the ears, nausea, vomiting, blood in the urine, inability to urinate, difficulty speaking, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, drunkenness, numbness, blurred vision and lung congestion.
LONG TERM EFFECTS: In addition to effects from short term exposure, bloody spit, bloody vomit, asthma and menstrual disorders may occur. May also cause reproductive effects and cancer.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation, possibly severe. Additional effects may include drunkenness.
LONG TERM EFFECTS: Same effects as short term exposure.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include tearing.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: May cause vomiting, digestive disorders, blood in the stool, headache and drunkenness.
LONG TERM EFFECTS: May cause liver and kidney damage. May also cause cancer.
ADDITIONAL DATA: Drinking alcohol may worsen the effects.

CARCINOGEN STATUS:
OSHA: N
NTP: Y
IARC: Y

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Maintain airway, blood pressure and respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline,

occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- If the person is conscious and not convulsing, induce emesis by giving syrup of ipecac (keeping the head below the hips to prevent aspiration), followed by water. Repeat in 20 minutes if not effective initially. In patients with depressed respiration or if emesis is not produced, perform gastric lavage cautiously (Dreisbach, Handbook of Poisoning, 12th Ed.). Treat symptomatically and supportively. Gastric lavage should be performed by qualified medical personnel. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Negligible fire hazard when exposed to heat or flame.

EXTINGUISHING MEDIA:
Dry chemical or carbon dioxide
(1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam
(1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 74).

Extinguish using agent(s) suitable for type of surrounding fire. Avoid contamination of water sources and sewers. Build dikes to contain flow. Avoid breathing vapors; keep upwind.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include highly toxic fumes of phosgene, toxic and corrosive fumes of chlorides, and oxides of carbon.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Stop leak if you can do it without risk. For small liquid spills, take up with sand, earth or other absorbent material. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area] Keep unnecessary people away.

Reportable Quantity (RQ): 1 pound
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SOIL SPILL:
Dig a holding area such as a pit, pond or lagoon to contain spill and dike surface flow using barrier of soil, sandbags, foamed polyurethane or foamed concrete. Absorb liquid mass with fly ash or cement powder.

AIR SPILL:
Apply water spray to knock down and reduce vapors. Knock-down water is corrosive and toxic and should be diked for containment and later disposal.

WATER SPILL:
If dissolved, at a concentration of 10 ppm or greater, apply activated carbon at ten times the amount that has been spilled.

Use suction hoses to remove trapped spill material.

The California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) prohibits contaminating any known source of drinking water with substances known to cause cancer and/or reproductive toxicity.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in a cool, dry, well-ventilated location, away from any area where the fire hazard may be acute (NFPA 49, Hazardous Chemicals Data, 1975).

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
100 ppm OSHA TWA; 200 ppm OSHA ceiling; 300 ppm OSHA 5 minute/3 hour peak

25 ppm (170 mg/m3) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)
25 ppm (170 mg/m3) ACGIH TWA; 100 ppm (685 mg/m3) ACGIH STEL
ACGIH A3-Animal Carcinogen
50 ppm (339 mg/m3) DFG MAK TWA;
100 ppm (678 mg/m3) DFG MAK 30 minute peak, average value, 4 times/shift

Measurement method: Charcoal tube; carbon disulfide; gas chromatography with flame ionization detection; (NIOSH III # 1003, Halogenated Hydrocarbons).

100 pound CERCLA Section 103 Reportable Quantity
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting
Subject to California Proposition 65 cancer and/or reproductive toxicity warning and release requirements- (April 1, 1988)

VENTILATION:
Process enclosure recommended to meet published exposure limits.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

TETRACHLOROETHYLENE:
At any detectable concentration-
Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode.
Supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Clear, colorless, volatile liquid with a mild ether-like odor.
MOLECULAR WEIGHT: 165.83
MOLECULAR FORMULA: CL2-C-C-CL2
BOILING POINT: 250 F (121 C)
FREEZING POINT: -2 F (-19 C)
VAPOR PRESSURE: 14 mmHg @ 20 C
VAPOR DENSITY: 5.83
SPECIFIC GRAVITY: 1.6227
WATER SOLUBILITY: 0.015%
VOLATILITY: 100%
PH: no data available
ODOR THRESHOLD: 50 ppm
EVAPORATION RATE: (butyl acetate=1) 2.8
SOLVENT SOLUBILITY: Soluble in alcohol, ether, benzene, chloroform, oils, hexane.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
May burn but does not ignite readily. Container may explode in heat of fire.

INCOMPATIBILITIES:
TETRACHLOROETYLENE (PERCHLOROETHYLENE):
ACIDS (STRONG): Incompatible.
ALUMINUM: May form explosive mixture.
BARIUM: Forms a detonable mixture.
BASES: May form explosive mixture.
BERYLLIUM: Possible explosive mixture.
DINITROGEN TETRAOXIDE: Explosive when subjected to extreme shock.
METALS (LIGHT): Violent reaction.
OXIDIZERS: Incompatible.
OXYGEN (LIQUID): Incompatible.
PLASTICS, RUBBER, AND COATINGS: May be attacked.
POTASSIUM HYDROXIDE: May form explosive mixture.
SODIUM HYDROXIDE: May form explosive mixture.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include highly toxic fumes of phosgene, toxic and corrosive fumes of chlorides, and oxides of carbon.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
IRRITATION DATA: 810 mg/24 hours skin-rabbit severe; 500 mg/24 hours skin-rabbit mild; 162 mg eye-rabbit mild; 500 mg/24 hours eye-rabbit mild.
TOXICITY DATA: 96 ppm/7 hours inhalation-human TCLo; 600 ppm/10 minutes inhalation-man TCLo; 34,200 mg/m3/8 hours inhalation-rat LC50; 5200 ppm/4 hours inhalation-mouse LC50; 1750 ppm/6 hours/14 days intermittent inhalation-rat TCLo; 19300 mg/m3/24 hours/94 days continuous inhalation-rat TCLo; 1750 ppm/6 hours/14 days intermittent inhalation-mouse TCLo; 1600 ppm/6 hours/13 weeks intermittent inhalation-mouse TCLo; 120 ppm/24 hours/1 year-continuous inhalation-gerbil TCLo; >3228 mg/kg skin-rabbit LD; >10,000 mg/kg skin-rabbit LD50 (Dow MSDS); 545 mg/kg oral-child TDLo; 2629 mg/kg oral-rat LD50; 8100 mg/kg oral-mouse LD50; 5 gm/kg oral-rabbit LDLo; 4 gm/kg oral-cat LDLo; 4 gm/kg oral-dog LDLo; 36 gm/kg/90 days continuous oral-rat TDLo; 2200 mg/kg subcutaneous-rabbit LDLo; 65 gm/kg subcutaneous-mouse LD50; 85 mg/kg intravenous-dog LDLo; 4678 mg/kg intraperitoneal-rat LD50; 2100 mg/kg intraperitoneal-dog LD50; mutagenic data (RTECS); reproductive effects data (RTECS); tumorigenic data (RTECS).
CARCINOGEN STATUS: Anticipated Human Carcinogen (NTP); Human Inadequate Evidence, Animal Sufficient Evidence (IARC Group-2B). In mice, oral administration and inhalation produced hepatocellular carcinomas in both sexes. Exposure of rats by inhalation produced an increased incidence of mononuclear cell leukemia in both sexes.
LOCAL EFFECTS: Irritant- inhalation, skin, eyes.
ACUTE TOXICITY LEVEL: Moderately toxic by ingestion; slightly toxic by inhalation and dermal absorption.
TARGET EFFECTS: Central nervous system depressant. Poisoning may also affect the liver and kidneys.
AT INCREASED RISK FROM EXPOSURE: Persons with pre-existing skin, eye, liver, kidney, cardiovascular or neurological disorders.
ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation. May be excreted in breast milk. One study shows an increased risk of leukemia for children whose fathers had occupational exposure to chlorinated solvents after the birth of the child. A significant excess of bladder cancer mortality and elevated digestive tract cancer mortality, as well as, excess esophageal cancer has been associated with tetrachloroethylene use in the dry-cleaning industry.

HEALTH EFFECTS
INHALATION:
TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
IRRITANT/NARCOTIC/CARCINOGEN.
150 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- Vapor concentrations from 100-400 ppm may cause irritation of the nose, throat and mucous membranes, flushed face and neck, sinus congestion, nasal discharge, headache, dizziness, lightheadedness, drowsiness, thick tongue, tightness around the mouth, slurred speech,

confusion, incoordination, nausea, and reversible liver and kidney changes; 400-600 ppm may cause salivation, metallic taste, perspiration of the hands, and loss of inhibitions; 1000-2000 ppm may cause marked upper respiratory irritation, anesthesia of the lips and nose, congested eustachian tubes, aching facial muscles, inebriation, exhilaration, mental sluggishness, lassitude, gagging, faintness, tinnitus, dyspnea upon exertion, narcosis, and liver and kidney damage. Other reported symptoms include weakness, ataxia, coughing, chest pains, rapid, weak pulse, blurred vision, irritability, anorexia, vomiting, hallucinations, distorted perceptions, acidosis, latent jaundice and abnormal liver function tests, albuminuria, hematuria, anuria, and premature ventricular beats. Massive exposures may cause pulmonary edema, unconsciousness, coma and death from anesthesia or respiratory arrest. In one fatal case, pathologic findings included central fatty necrosis and fatty infiltration of the liver and moderate cloudy swelling of the renal tubular epithelium. Epinephrine-induced cardiac arrhythmias have occurred with some hydrocarbons, but testing of tetrachloroethylene in dogs has been negative.

CHRONIC EXPOSURE- Workers exposed to 1-40 ppm over 7.5 years showed altered electrodiagnostic and neurological rating scores; 4 0f 16 exposed to 60-450 ppm for 2-20 years had abnormal EEG's. Repeated exposure may also cause respiratory tract irritation, central nervous system depression without narcosis, confusion, headache, fatigue, dizziness, inebriation, insomnia, nausea, anorexia, abdominal pain, constipation, blurred vision, multiple premature ventricular beats, and peripheral neuropathy with numbness in the fingers, trembling, neuritis, and memory defects. Hepatic damage may occur and be persistent. Exposure to levels around 250 ppm for 4 months has been reported to have caused hemoptysis, coughing, sweating attacks, jaundice, oliguria, hematemesis, cardiovascular failure and death. Occasional idiosyncratic reactions have been reported including pulmonary edema, bronchial asthma, dependency, and hypersensitivity. Chronic studies in rats have produced liver and kidney damage. In studies of women working in the dry cleaning industry, one study showed higher incidences of menstrual disorders, indicating an effect on the hormone system. Another study revealed an association between exposure during early pregnancy and a significantly increased incidence of spontaneous abortions. Reproductive effects have also been reported in animals. Inhalation studies indicate an increased incidence of liver carcinomas in mice and mononuclear cell leukemia in rats.

SKIN CONTACT:
TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
IRRITANT/NARCOTIC.

ACUTE EXPOSURE- Brief immersion of the hands in the liquid usually causes only mild irritation. However, the liquid on the skin for 40 minutes resulted in a progressively severe burning sensation, beginning within 5-10 minutes, and marked erythema, which subsided after 1-2 hours. Severe exposures may result in vesiculation and possibly burns. Absorption may occur but is probably not a significant route of exposure.

CHRONIC EXPOSURE- Repeated or prolonged skin contact may produce dermatitis with dry, scaly, fissured skin.

EYE CONTACT:
TETRACHLOROETYLENE (PERCHLOROETHYLENE):
IRRITANT.

ACUTE EXPOSURE- Vapor concentrations from 100-200 may cause mild irritation. Higher levels or direct contact may cause pain, lacrimation, and burning, but serious injury is unlikely. At 1500 pmm, the irritation is almost intolerable. Two studies of direct application to rabbit eyes resulted in conjunctivitis and effects on the corneal epithelium; recovery was complete in 2 days to 2 weeks.

CHRONIC EXPOSURE- Repeated or prolonged exposure may cause conjunctivitis. One study has reported an increased incidence of lacrimal duct disease in exposed workers.

INGESTION:
TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
NARCOTIC/CARCINOGEN.
ACUTE EXPOSURE- May cause severe gastrointestinal irritation with nausea, vomiting, abdominal cramps and diarrhea, possibly with bloody stools. Narcotic effects may include headache, dizziness, exhilaration, inebriation and other effects as in acute inhalation. A dose of 500 mg/kg was ingested and survived. Dogs given lethal doses exhibited cardiac and respiratory depression; autopsy revealed fatty infiltration of the heart and liver and marked inflammation and shriveling of the small intestine.
CHRONIC EXPOSURE- Long-term ingestion of 50 mg/kg produced liver and kidney damage in mice. Chronic ingestion has produced hepatocellular carcinomas in mice.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40CFR 262. EPA Hazardous Waste Number U210.

Tetrachloroethylene - Regulatory level: 0.7 mg/l (TCLP-40 CFR 261 Appendix II) materials which contain the above substance at or above the TCLP regulatory level meet the EPA toxicity characteristic, and must be disposed of in accordance with 40 CFR part 262. EPA Hazardous Waste Number D039.

US EPA RCRA Hazardous Waste Number: RCRA U210

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Tetrachloroethylene-UN 1897

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
6.1 - Poisonous materials

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG III

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101
AND SUBPART E:
Keep away from food

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.153
NON-BULK PACKAGING: 49 CFR 173.203
BULK PACKAGING: 49 CFR 173.241

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 60 L
CARGO AIRCRAFT ONLY: 220 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
TETRACHLOROETHYLENE (PERCHLOROETHYLENE)		100 pounds RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
TETRACHLOROETHYLENE (PERCHLOROETHYLENE)		
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	Y	
TETRACHLOROETHYLENE (PERCHLOROETHYLENE)		

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MSDS: TOLUENE

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

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FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 108-88-3
RTECS NUMBER: XS5250000

SUBSTANCE: TOLUENE

TRADE NAMES/SYNONYMS:
BENZENE, METHYL-; METHYLBENZENE; 1-METHYLBENZENE; METHYLBENZOL; PHENYLMETHANE; METHANE, PHENYL-; METHACIDE; TOLUOL; AMSCO SOLV 1410, TOLUENE (UNION OIL COMPANY); DIAPHRAGM REPAIR KIT SOLVENT FOR HL29 & M8-M9 KITS (3M); POLYSTYRENE Q-DOPE THINNER 104102 & 10-4104; PRINT COAT SOLVENT 13-2; 0-DOPE THINNER (GC ELECTRONICS); TAFA SPRAY GUARD SP (TAFA INC); CUSTOM REDUCER 170; RCRA U220; UN 1294; STCC 4909305; C7H8; OHS23590

CHEMICAL FAMILY:
Hydrocarbon, aromatic

CREATION DATE: 10/25/84 REVISION DATE: 03/06/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : TOLUENE
CAS NUMBER: 108-88-3
PERCENTAGE: 100.0

OTHER CONTAMINANTS: NONE.

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2  REACTIVITY=0

NFPA Ratings: Health=2 Fire=3 Reactivity=0

EMERGENCY OVERVIEW:
Clear, colorless liquid with an aromatic odor.
Causes respiratory tract, skin, and eye irritation. May damage nerves. May affect the central nervous system.
Flammable liquid and vapor. May cause flash fire.
Keep away from all ignition sources. Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include lack of sense of smell, metallic taste, nausea, headache, drowsiness, drunkenness, tingling sensation, dilated pupils, liver and kidney damage and nerve damage.
LONG TERM EFFECTS: In addition to effects from short term exposure, ringing in the ears, stomach pain, bloody vomit, difficulty speaking, chest pain, irregular heartbeat, fainting, loss of memory, menstrual disorders, blood disorders, liver enlargement, paralysis, brain damage, coma and heart failure may occur.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation.
LONG TERM EFFECTS: Same effects as short term exposure.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation, possibly severe.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: May cause effects as reported in other routes of exposure. Additional effects may include drunkenness and lung congestion.
LONG TERM EFFECTS: May cause reproductive effects.
ADDITIONAL DATA: Drinking alcohol may worsen the effects.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- Extreme care must be used to prevent aspiration. Gastric lavage with a cuffed endotracheal tube in place to prevent further aspiration should be done within 15 minutes. In the absence of depression or convulsions or impaired gag reflex, emesis can also be induced using syrup of ipecac without increasing the hazard of aspiration (Dreisbach, Handbook of Poisoning, 12th Ed.). Treat symptomatically and supportively. Gastric lavage should be performed by qualified medical personnel. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Dangerous fire hazard when exposed to heat or flame.

Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.

Vapor-air mixtures are explosive.

Due to low electroconductivity of the substance, flow or agitation may generate electrostatic charges resulting in sparks with possible ignition.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 27).

Extinguish only if flow can be stopped; use water in flooding quantities as fog, solid streams may spread fire. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing toxic vapors, keep upwind.

Water may be ineffective. (NFPA 325, Fire Hazard Properties of Flammable

Liquids, Gases, and Volatile Solids, 1994).

FLASH POINT: 40 F (4 C) (CC)
LOWER FLAMMABLE LIMIT: 1.2%
UPPER FLAMMABLE LIMIT: 7.1%
AUTOIGNITION: 896 F (480 C)
FLAMMABILITY CLASS(OSHA): IB

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of carbon and various hydrocarbons.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Stop leak if you can do it without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area. Keep unnecessary people away; isolate hazard area and restrict entry.

Reportable Quantity (RQ): 1000 pounds
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SOIL SPILL:
Dig holding area such as lagoon, pond or pit for containment.

Dike flow of spilled material using soil or sandbags or foamed barriers such as polyurethane or concrete.

Use cement powder or fly ash to absorb liquid mass.

Immobilize spill with universal gelling agent.

Reduce vapor and fire hazard with appropriate foam.

AIR SPILL:
Knock down vapors with water spray. Keep upwind.

WATER SPILL:
If material dissolved, apply activated carbon. Use dredges or lifts to extract masses of pollution and precipitates. Apply universal gelling agent to immobilize trapped spill and increase efficiency of removal. Limit spill motion and dispersion with natural barriers or oil spill control booms. Use soaps, detergents, alcohols or other surface active agent to thicken spilled material. Use suction hoses to remove trapped spill material.

The California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) prohibits contaminating any known source of drinking water

with substances known to cause cancer and/or reproductive toxicity.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 29 CFR 1910.106.

Protect against physical damage. Outside or detached storage is preferable. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials (NFPA 49, hazardous chemicals data, 1975).

Bonding and grounding: Substances with low electroconductivity, which may be ignited by electrostatic sparks, should be stored in containers which meet the bonding and grounding guidelines specified in NFPA 77-1983, Recommended Practice on Static Electricity.

Keep container closed.

Keep cool.

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
TOLUENE:
200 ppm OSHA TWA; 300 ppm OSHA ceiling; 500 ppm OSHA 10 minute peak
100 ppm (377 mg/m3) OSHA TWA (vacated by 58 FR 35338, June 30, 1993);
150 ppm (565 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
50 ppm (188 mg/m3) ACGIH TWA (skin)
ACGIH A4-Not Classifiable as a Human Carcinogen (Proposed Addition 1995-96)
100 ppm (377 mg/m3) NIOSH recommended 10 hour TWA;
150 ppm (565 mg/m3) NIOSH recommended STEL
100 ppm (377 mg/m3) DFG MAK TWA;
500 ppm (1885 mg/m3) DFG MAK 30 minute peak, average value, 2 times/shift

Measurement method: Charcoal tube; carbon disulfide; gas chromatography with flame ionization detection; (NIOSH III # 1500, Hydrocarbons).

1000 pounds CERCLA Section 103 Reportable Quantity
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting
Subject to California Proposition 65 cancer and/or reproductive toxicity warning and release requirements- (January 1, 1991)

VENTILATION:
Provide local exhaust or general dilution ventilation to meet published exposure limits. Ventilation equipment should be explosion-proof if explosive

concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

TOLUENE:
500 ppm- Any chemical cartridge respirator with organic vapor cartridge(s).
Any powered air-purifying respirator with organic vapor cartridge(s).
Any air-purifying full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister.
Any supplied-air respirator.
Any self-contained breathing apparatus that has a full facepiece.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Clear, colorless liquid with an aromatic odor.
MOLECULAR WEIGHT: 92.14

MOLECULAR FORMULA: C6-H5-C-H3
BOILING POINT: 231 F (111 C)
FREEZING POINT: -139 F (-95 C)
VAPOR PRESSURE: 22 mmHg @ 20 C
VAPOR DENSITY: 3.14
SPECIFIC GRAVITY: 0.8669
WATER SOLUBILITY: 0.05% @ 20 C
VOLATILITY: 100%
PH: no data available
ODOR THRESHOLD: 10-15 ppm
EVAPORATION RATE: (butyl acetate=1) 2.24
SOLVENT SOLUBILITY: Soluble in alcohol, ether, benzene, chloroform, ligroin, glacial acetic acid, carbon disulfide, acetone.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
Avoid contact with heat, sparks, flames, or other sources of ignition. Vapors may be explosive. Avoid overheating of containers; containers may violently rupture in heat of fire. Avoid contamination of water sources.

INCOMPATIBILITIES:
TOLUENE:
ALLYL CHLORIDE + DICHLOROETHYL ALUMINUM OR ETHYLALUMINUM SESQUICHLORIDE: Possible explosion.
BROMINE TRIFLUORIDE (SOLID): Violent reaction.
1,3-DICHLORO-5,5-DIMETHYL-2,4-IMIDAZOLIDIDIONE: Explosive reaction.
DINITROGEN TETRAFLUORIDE: Forms explosive mixture.
MINERAL ACIDS (STRONG): Incompatible.
NITRIC ACID: Vigorous reaction.
NITRIC ACID + SULFURIC ACID: Violent decomposition possible.
NITROGEN TETROXIDE: Explosive reaction.
OXIDIZERS (STRONG): Fire and explosion hazard.
PLASTICS, RUBBER, AND COATINGS: May be attacked.
SILVER PERCHLORATE: Forms shock-sensitive mixture.
SULFUR DICHLORIDE: Violent reaction, greatly accelerated in the presence of iron or ferric chloride.
SULFURIC ACID: Exothermic reaction.
TETRANITROMETHANE: Forms explosive mixture.
URANIUM HEXAFLUORIDE: Violent reaction.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of carbon and various hydrocarbons.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

TOLUENE:
IRRITATION DATA: 300 ppm eye-human; 870 ug eye-rabbit mild; 2 mg/24 hours eye-rabbit severe; 100 mg/30 seconds rinsed eye-rabbit mild; 435 mg skin-rabbit mild; 500 mg skin-rabbit moderate; 20 mg/24 hours skin-rabbit moderate.
TOXICITY DATA: 200 ppm inhalation-human TCLo; 100 ppm inhalation-man TCLo; 49 gm/m3/4 hours inhalation-rat LC50; 1600 ppm/20 hours/7 days-intermittent inhalation-rat TCLo; 80 ppm/6 hours/4 weeks-intermittent inhalation-rat TCLo; 12000 ppm/10 minutes/8 weeks-intermittent inhalation-rat TCLo; 2500 ppm/6.5 hours/15 weeks-intermittent inhalation-rat TCLo; 1500 ppm/6 hours/26 weeks-intermittent inhalation-rat TCLo; 300 ppm/6 hours/2 years intermittent inhalation-rat TCLo; 400 ppm/24 hours inhalation-mouse LC50; 12000 ppm/10 minutes/8 weeks-intermittent inhalation-mouse TCLo; 1250 ppm/6 hours/14 weeks-intermittent inhalation-mouse TCLo; 55000 ppm/40 minutes inhalation-rabbit LCLo; 50 mg/m3/4 hours/26 weeks-intermittent inhalation-rabbit TCLo; 1600 ppm inhalation-guinea pig LCLo; 30 gm/m3 inhalation-mammal LC50; 12124 mg/kg skin-rabbit LD50; 636 mg/kg oral-rat LD50; 162 gm/kg/13 weeks-intermittent oral-rat TDLo; 227 gm/kg/13 weeks intermittent oral-mouse TDLo; 2940 mg/kg/4 weeks-continuous oral-mouse TDLo; 4 gm/kg oral-mammal LD50; 2250 mg/kg subcutaneous-mouse LD50; 1960 mg/kg intravenous-rat LD50; 130 mg/kg intravenous-rabbit LDLo; 500 mg/kg intraperitoneal-guinea pig LD50; 1332 mg/kg intraperitoneal-rat LD50; 59 mg/kg intraperitoneal-mouse LD50; 1750 mg/kg intraperitoneal-mammal LDLo; 6900 mg/kg unreported-rat LD50; 2 gm/kg unreported-mouse LD50; mutagenic data (RTECS); reproductive effects data (RTECS).
CARCINOGEN STATUS: Human Inadequate Evidence, Animal Inadequate Evidence (IARC Group-3).
LOCAL EFFECTS: Irritant- inhalation, skin, eye.
ACUTE TOXICITY LEVEL: Moderately toxic by ingestion; slightly toxic by inhalation and dermal absorption.
TARGET EFFECTS: Central nervous system depressant; neurotoxin. Poisoning may also affect the heart, liver, kidneys, and blood.
ADDITIONAL DATA: Stimulants such as epinephrine may induce ventricular fibrillation. Alcohol may enhance the toxic effects. The metabolism of other solvents may be inhibited resulting in a potentiation of toxic effects of those chemicals. Uptake is directly proportional to the amount of body fat. Blood levels may be cumulative when exposure is extended.

HEALTH EFFECTS
INHALATION:
TOLUENE:
IRRITANT/NARCOTIC/NEUROTOXIN.
500 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- Odor detection may be insufficient for warning due to olfactory fatigue. Exposure to 100 ppm may cause irritation. 200-600 ppm for up to 8 hours caused fatigue, weakness, confusion, headache, nausea, impaired coordination and reaction time, paresthesias of the skin, euphoria, dizziness, and dilated pupils. 800 ppm caused rapid irritation, nasal mucous secretion, metallic taste, drowsiness, and impaired balance. After effects including nervousness, muscular fatigue, and insomnia lasted for several days. A worker found unconscious after exposure to high vapor concentrations for 18 hours developed hepatic and renal damage with myoglobinuria. Recovery was complete within 6 months. Hematologic effects occur rarely with exposure to high concentrations. Death may be due to respiratory failure or ventricular fibrillation.
CHRONIC EXPOSURE- Prolonged or repeated exposure may cause mucous membrane

irritation, vomiting, insomnia, nosebleeds, chest pains, euphoria, headache, vertigo, nausea, anorexia, momentary loss of memory, loss of coordination and impairment of reaction time, tinnitus, impaired speech, vision, and/or hearing, alcohol intolerance, and petechiae and abnormal bleeding. Bone marrow hypoplasia and leukopenia have been reported occasionally, but may be due to benzene contamination. Examination of workers exposed to 100-1100 ppm revealed hepatomegaly, mild macrocytosis, moderate erythropenia, and absolute lymphocytosis but no leukopenia. Other workers exposed to toluene fumes developed leukopenia and especially neutropenia. Within 6 months, they showed decreased prothrombin level and increased coagulation time. Periodontal effects were also noted. Volunteers exposed to 200 ppm for 6 hours/day for 2 days showed a significant increase in heart rate. Cardiac sensitization may occur and may result in cardiac arrest due to ventricular fibrillation. Repeated inhalation to the point of euphoria has caused irreversible encephalopathy with cerebellar ataxia, rhythmic limb movements, disequilibrium, bizarre behavior, emotional lability, optic atrophy, and diffuse cerebral atrophy. Other neuropsychiatric effects may include dizziness, syncope, paresthesias, peripheral neuropathy, hallucinations, lethargy, and coma. Intentional sniffing can produce renal tubular defects with metabolic acidosis, electrolyte abnormalities and potassium loss. Severe muscle weakness leading to limb paralysis and cardiac arrhythmias may result from the hypokalemia; however, sensory function and tendon reflexes are not impaired. Gastrointestinal effects may include abdominal pain, nausea, vomiting, and hematemesis. Chromosome changes were observed in some workers up to two years after cessation of exposure to toluene. Women occupationally exposed to toluene and other varnish solvents have reported menstrual disorders, underweight offspring who did not nurse well, and fetal asphyxia. One case study indicated toluene apparently crossed the placenta and created cerebellar damage in an unborn infant. Dysmenorrhea has been reported in women occupationally exposed to toluene levels of 60-100 ppm. Reproductive effects have also been reported in animals.

SKIN CONTACT:
TOLUENE:
IRRITANT.
ACUTE EXPOSURE- Contact with the liquid may cause irritation. Vapors may cause drying. Skin absorption does occur, but it is generally too slow to produce signs of acute systemic toxicity.
CHRONIC EXPOSURE- Prolonged or repeated contact with the liquid may cause defatting of the skin with a dry fissured dermatitis. Repeated application to rabbit skin produced slight to moderate irritation and slight necrosis. Topical application of 10 gm/kg produced an increase in plasmic and lymphoid reticular cells in bone marrow of rats, while 1 gm/kg had no effect.

EYE CONTACT:
TOLUENE:
IRRITANT.
ACUTE EXPOSURE- Liquid may cause irritation and corneal burns if not promptly removed. Concentrations around 300-800 ppm may cause noticeable irritation and lacrimation. Corneal lesions and very fine vacuoles have been reported in workers exposed to a solvent containing toluene. The lesions subsided following several days of non-exposure. Similar lesions have been produced in cats following exposure to toluene.
CHRONIC EXPOSURE- Repeated or prolonged contact with irritants may cause conjunctivitis.

INGESTION:
TOLUENE:

NARCOTIC.
ACUTE EXPOSURE- May cause a burning sensation in the epigastrium and abdominal spasms. Systemic effects may occur as described in acute inhalation. Aspiration of the liquid into the lungs may cause coughing, gagging, distress, acute hemorrhagic pneumonitis, and rapidly developing pulmonary edema. The approximate lethal dose in humans is 15-30 ml.
CHRONIC EXPOSURE- No effects were reported in rats fed up to 590 mg/kg/day for 193 days. Administration to animals during gestation produced significant embryolethality and an increase in cleft palate in offspring.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40CFR 262. EPA Hazardous Waste Number U220.

US EPA RCRA Hazardous Waste Number: RCRA U220

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Toluene-UN 1294

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
3 - Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:

PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101
AND SUBPART E:
Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 5 L
CARGO AIRCRAFT ONLY: 60 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
TOLUENE		1000 pounds RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
TOLUENE		
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	Y	
TOLUENE		

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	Y
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MSDS: TRICHLOROETHYLENE

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 79-01-6
RTECS NUMBER: KX4550000

SUBSTANCE: TRICHLOROETHYLENE

TRADE NAMES/SYNONYMS:
ACETYLENE TRICHLORIDE; ETHYLENE TRICHLORIDE; ALGYLEN;
1-CHLORO-2,2-DICHLOROETHYLENE; 1,1-DICHLORO-2-CHLOROETHYLENE; TCE; ANAMENTH;
ETHINYL TRICHLORIDE; TRICHLOROETHENE; 1,1,2-TRICHLOROETHYLENE;
ETHYLENE, TRICHLORO-; CHLORYLEN; 1,1,2-TRICHLOROETHENE; ETHENE, TRICHLORO-;
NEU-TRI (R) SOLVENT (DOW CHEMICAL); BLACO-TRI (BARON-BLAKESLEE); UN 1710;
RCRA U228; STCC 4941171; C2HCL3; OHS23850

CHEMICAL FAMILY:
Halogen compound, aliphatic

CREATION DATE: 10/24/84 REVISION DATE: 01/22/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : TRICHLOROETHYLENE
CAS NUMBER: 79-01-6
PERCENTAGE: >99

OTHER CONTAMINANTS: TRACES OF AMINES OR EPOXIDES AS INHIBITORS.

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2  REACTIVITY=0
NFPA Ratings: Health=2 Fire=1 Reactivity=0

EMERGENCY OVERVIEW:
Colorless liquid with a mild chloroform-like odor.
Causes respiratory tract, skin, and eye irritation. May cause allergic skin reaction. May affect the central nervous system.
Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Avoid repeated or prolonged contact. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include nausea, vomiting, stomach pain, difficulty breathing, low blood pressure, headache, drowsiness, drunkenness, disorientation, numbness, twitching, visual disturbances, bluish skin color, lung congestion, liver and kidney damage, nerve damage, coma and heart failure.
LONG TERM EFFECTS: In addition to effects from short term exposure, wheezing, irregular heartbeat, liver damage and brain damage may occur.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation. May cause allergic reactions. Additional effects may include blisters.
LONG TERM EFFECTS: In addition to effects from short term exposure, nausea, wheezing, joint pain and paralysis may occur.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include burns, tearing and blurred vision.
LONG TERM EFFECTS: In addition to effects from short term exposure, blindness may occur.
INGESTION:
SHORT TERM EFFECTS: May cause nausea, vomiting, diarrhea, irregular heartbeat, headache, drunkenness, numbness, loss of memory, kidney damage, paralysis, convulsions and coma.
LONG TERM EFFECTS: In addition to effects from short term exposure, drowsiness may occur.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of

immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- Remove by gastric lavage or emesis. Maintain blood pressure and airway. Give oxygen if respiration is depressed. Do not perform gastric lavage or emesis if victim is unconscious. Get medical attention immediately (Dreisbach, Handbook of Poisoning, 12th Ed.). Administration of gastric lavage or oxygen should be performed by qualified medical personnel.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Slight fire hazard when exposed to heat or flame.

EXTINGUISHING MEDIA:
Dry chemical or carbon dioxide
(1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam
(1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 74).

Use agent suitable for type of fire. Avoid breathing toxic vapors, keep upwind.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: 7.8% @ 100 C
UPPER FLAMMABLE LIMIT: 52% @ 100 C
AUTOIGNITION: 770 F (410 C)

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include highly toxic fumes of phosgene, toxic and corrosive fumes of chlorides, and oxides of carbon.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Stop leak if you can do it without risk. For small liquid spills, take up with sand, earth or other absorbent material. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area] Keep unnecessary people away.

Reportable Quantity (RQ): 100 pounds
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SOIL SPILL:
Dig a holding area such as a pit, pond or lagoon to contain spill and dike surface flow using barrier of soil, sandbags, foamed polyurethane or foamed concrete. Absorb liquid mass with fly ash or cement powder.

AIR SPILL:
Apply water spray to knock down and reduce vapors. Knock-down water is corrosive and toxic and should be diked for containment.

WATER SPILL:
Use activated carbon to absorb spilled substance that is dissolved.

Use suction hoses to remove trapped spill material.

Use mechanical dredges or lifts to extract immobilized masses of pollution and precipitates.

The California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) prohibits contaminating any known source of drinking water with substances known to cause cancer and/or reproductive toxicity.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in a cool, dry, well-ventilated location, away from any area where the fire hazard may be acute (NFPA 49, Hazardous Chemicals Data, 1975).

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
TRICHLOROETHYLENE:
100 ppm OSHA TWA; 200 ppm OSHA ceiling; 300 ppm OSHA 5 minute/2 hour peak
50 ppm (269 mg/m3) OSHA TWA (vacated by 58 FR 35338, June 30, 1993);
200 ppm (1070 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
50 ppm (269 mg/m3) ACGIH TWA; 100 ppm (537 mg/m3) ACGIH STEL
ACGIH A5-Not Suspected as a Human Carcinogen
50 ppm (269 mg/m3) DFG MAK TWA;
250 ppm (1344 mg/m3) DFG MAK 30 minute peak, average value, 2 times/shift

Measurement method: Charcoal tube; carbon disulfide; gas chromatography with flame ionization detection; (NIOSH III # 1022).

100 pounds CERCLA Section 103 Reportable Quantity
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting
Subject to California Proposition 65 cancer and/or reproductive toxicity warning and release requirements- (April 1, 1988)

VENTILATION:
Provide local exhaust ventilation system to meet published exposure limits.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

TRICHLOROETHYLENE:
At any detectable concentration:
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Colorless liquid with a mild chloroform-like odor.
MOLECULAR WEIGHT: 131.39
MOLECULAR FORMULA: CL-C-H-C-CL2
BOILING POINT: 189 F (87 C)
FREEZING POINT: -99 F (-73 C)
VAPOR PRESSURE: 58 mmHg @ 20 C
VAPOR DENSITY: 4.53
SPECIFIC GRAVITY: 1.4642
WATER SOLUBILITY: 0.1%
PH: no data available
ODOR THRESHOLD: 21 ppm
EVAPORATION RATE: (carbon tetrachloride=1) 0.69
SOLVENT SOLUBILITY: Soluble in alcohol, ether, acetone, chloroform, benzene, and vegetable oils.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures in a closed container. Uninhibited material, on heating or exposure to light, may decompose or polymerize, releasing hydrogen chloride.

CONDITIONS TO AVOID:
May burn but does not ignite readily. Container may explode in heat of fire.

INCOMPATIBILITIES:
TRICHLOROETHYLENE:
ALKALI: Forms explosive mixture.
ALUMINUM + DILUTE HYDROCHLORIC ACID: Violent poymerization.
ALUMINUM: Violent decomposition may occur on contact with aluminum powder or freshly formed surfaces.
BARIUM: Possible detonation.
BERYLLIUM: Forms impact-sensitive mixture.
BORON: Forms explosive or ignitable compound.
1-CHLORO-2,3-EPOXYPROPANE: Forms explosive mixture.
2,4-BIS(4(2',3'-EPOXYPROPOXY)PHENYL)PROPANE: Forms explosive mixture.
DI-2,3-EPOXYPROPYL ETHER OF 1,4-BUTANEDIOL: Forms explosive mixture.
EPOXIDES: Possible explosion.

LITHIUM: Forms impact-sensitive mixture.
MAGNESIUM: Forms impact-sensitive mixture.
METALS (POWDERED): Forms explosive or ignitable compound.
MONO-2,3-EPOXYPROPYL ETHER OF 1,4-BUTANEDIOL: Forms explosive mixture.
NITROGEN TETRAOXIDE: Forms explosive mixture.
OXIDIZERS (STRONG): Fire and explosion hazard.
OXYGEN (LIQUID): Explodes when initiated with a blasting cap.
OXYGEN (GAS): Explodes under pressure at room temperature.
PERCHLORIC ACID: Violent reaction.
POTASSIUM: Forms explosive chloroacetylenes.
POTASSIUM HYDROXIDE: Forms explosive dichloroacetylene when heated.
SODIUM: Forms explosive chloroacetylenes.
SODIUM HYDROXIDE: Forms explosive chloroacetylenes.
TITANIUM (POWDER): Forms impact-sensitive mixture.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include highly toxic fumes of phosgene, toxic and corrosive fumes of chlorides, and oxides of carbon.

POLYMERIZATION:
May polymerize when catalyzed by aluminum chloride in a self-sustaining reaction which may develop temperatures up to 1350 C. A stabilizer is required to prevent polymerization when heated or exposed to sunlight.

SECTION 11

TOXICOLOGICAL INFORMATION

TRICHLOROETHYLENE:
IRRITATION DATA: 2 mg/24 hours skin-rabbit severe; 20 mg/24 hours eye-rabbit moderate.
TOXICITY DATA: 6900 mg/m3/10 minutes inhalation-human TCLo; 160 ppm/83 minutes inhalation-human TCLo; 812 mg/kg inhalation-human TDLo; 110 ppm/8 hours inhalation-man TCLo; 2900 ppm inhalation-man LCLo; 8000 ppm/4 hours inhalation-rat LCLo; 8450 ppm/4 hours inhalation-mouse LC50; 11,000 ppm inhalation-rabbit LCLo; 32,500 mg/m3/2 hours inhalation-cat LCLo; 37,200 ppm/40 minutes inhalation-guinea pig LCLo; 4380 ppm/4 hours/2 weeks-intermittent inhalation-rat TCLo; 3825 mg/m3/8 hours/6 weeks-intermittent inhalation-dog TCLo; >20 gm/kg skin-rabbit LD50; 7 gm/kg oral-human LDLo; 2143 mg/kg oral-man TDLo; 5650 mg/kg oral-rat LD50; 2402 mg/kg oral-mouse LD50; 7330 mg/kg oral-rabbit LDLo; 5864 mg/kg oral-cat LDLo; 97500 mg/kg/13 weeks-intermittent oral-mouse TDLo; 49080 mg/kg/17 weeks-continuous oral-mouse TDLo; 3363 mg/kg/14 days-intermittent oral-mouse TDLo; 182 gm/kg/26 weeks-continuous oral-mouse TDLo; 13 gm/kg/ 5 days-intermittent oral-mouse TDLo; 3360 mg/kg/14 days-intermittent oral-mouse TDLo; 16 gm/kg subcutaneous-mouse LD50; 1800 mg/kg subcutaneous-rabbit LDLo; 150 mg/kg subcutaneous-dog LDLo; 33,900 ug/kg intravenous-mouse LD50; 150 mg/kg intravenous-dog LDLo; 1282 mg/kg intraperitoneal-rat LD50; 1900 mg/kg intraperitoneal-dog LD50; mutagenic data (RTECS); reproductive effects data (RTECS); tumorigenic data (RTECS).
CARCINOGEN STATUS: Human Inadequate Evidence, Animal Limited Evidence (IARC Group-3). Repeated oral administration produced hepatocellular carcinomas in male and female mice; hepatocellular adenomas in female mice; lung tumors in male and female mice; tubular cell neoplasms of the kidney and interstitial cell neoplasms of the testis in rats. Inhalation exposures resulted in increased incidences of liver and lung tumors in male and female mice and low incidences of adenocarcinomas of the renal tubules in rats.

LOCAL EFFECTS: Irritant- inhalation, skin, eye.
ACUTE TOXICITY LEVEL: Moderately toxic by ingestion. Slightly toxic by inhalation. Relatively non-toxic by dermal absorption.
TARGET EFFECTS: Sensitizer- dermal; central nervous system depressant. Poisoning may affect the liver, kidneys, lung and heart.
AT INCREASED RISK FROM EXPOSURE: Person with pre-existing heart disease.
ADDITIONAL DATA: The presence of tetrachloroethane as an impurity, or the consumption of alcoholic beverages, caffeine, or other drugs may enhance the systemic toxicity. Epinephrine or other stimulants may induce ventricular arrhythmias. May cross the placenta. One study shows an increased risk of leukemia for children whose fathers had occupational exposure to chlorinated solvents after the birth of the child. The incidence of kidney cancer is statistically elevated among workers exposed to trichloroethylene. One study suggest that exposure to high concentrations over prolonged periods of time may cause renal tumors in humans.

HEALTH EFFECTS
INHALATION:
TRICHLOROETHYLENE:
IRRITANT/NARCOTIC.
1000 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- May cause mild irritation of the respiratory tract. Levels of 250-1000 ppm have caused impaired judgement and coordination. 1000-5000 ppm has caused excitation followed by central nervous system depression with drowsiness, dizziness, headache, nausea, vomiting, unconsciousness and coma. If consciousness is regained, nausea and vomiting may follow for several hours. Psychotic effects may include euphoria, disorientation, visual disturbances and hallucinations, and delusions. Other effects may include weakness, abdominal cramps, pallor, dyspnea, tachypnea, irregular pulse and heartbeat, pulmonary edema, hypotension, anesthesia, tremors, profuse perspiration, cyanosis, and rarely convulsions. Death may occur from respiratory arrest or ventricular fibrillation resulting in primary cardiac failure. Liver and kidney damage may also occur. Animal studies have also shown spleen damage. Trigeminal nerve damage and hepatotoxic effects have been attributed to exposure to the impure substance or to the decomposition products.
CHRONIC EXPOSURE- Repeated exposure to levels below 300 ppm may cause nausea, vomiting, headache, abdominal cramps, sleepiness, drunkenness, flushing, anorexia, swelling of the eyes, face and hands, and mild cardiac arrhythmias. Other symptoms may include wheezing, weight loss, anorexia, joint and muscle pain, anemia, cranial and peripheral neuropathies, anemia, chemical hepatitis, cirrhosis, and rarely jaundice. Intolerance to alcohol and tobacco, tremor, giddiness, anxiety and cardiac arrhythmias have been found in workers chronically exposed to 5-630 ppm. Liver, kidney and brain damage may also occur. Reproductive effects have been reported in animals. Administration to mice was associated with an increased incidence of liver and lung tumors and adenocarcinomas of the renal tubules in rats.

SKIN CONTACT:
TRICHLOROETHYLENE:
IRRITANT/SENSITIZER.
ACUTE EXPOSURE- May cause irritation and contact dermatitis. May cause sensitization in previously exposed individuals and result in generalized exfoliative or papulovesicular dermatitis, and erythroderma. Skin contact with soaked clothing for a long period of time may result in blistering. May be absorbed through the skin, however, dermal absorption is not likely to be of toxicological significance under normal use.
CHRONIC EXPOSURE- May cause a defatting type of dermatitis resulting in roughness, chapping, vesiculation and secondary infection. Repeated contact may result in paralysis of the fingers. Sensitization may occur.

Repeated low level exposure may cause inebriation, irritability, and personality changes. Chronic absorption may also produce weight loss, nausea, anorexia, fatigue, visual impairment, joint pain and wheezing. Jaundice is rare.

EYE CONTACT:
TRICHLOROETHYLENE:
IRRITANT.

ACUTE EXPOSURE- Direct contact with vapor or liquid may cause burns of the lids, conjunctiva and cornea with symptoms of redness, tearing and blurred vision. A splash in the eye may cause smarting pain and injury to the corneal epithelium which may regenerate with complete recovery.

CHRONIC EXPOSURE- Repeated and prolonged exposure may cause conjunctivitis, corneal inflammation, optic neuritis, double vision, nystagmus, changes in color perception and blindness.

INGESTION:
TRICHLOROETHYLENE:
NARCOTIC/LIMITED ANIMAL CARCINOGEN.

ACUTE EXPOSURE- May cause severe burning sensation in the mouth, throat, esophagus, and stomach, diarrhea, inebriation, confusion, tachycardia, and central nervous system depression with dizziness, nausea, vomiting, headache, collapse, convulsions, and coma followed by death from respiratory, cardiac or hepatorenal failure. Low-level concentrations may cause headache, amnesia, numbness, weakness of the extremities, hemiparesis and psychosis.

CHRONIC EXPOSURE- May cause irritation of mucous membranes, headache, drowsiness, fatigue, giddiness, excitability, indigestion, nausea, disturbances of sensations in the extremities and other symptoms noted in chronic inhalation. Reproductive effects have been reported in animals. Repeated oral administration produced liver and lung tumors in mice. Tubular cell neoplasms of the kidney and interstitial cell neoplasms of the testis were observed in rats.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40CFR 262. EPA Hazardous Waste Number U228.

Trichloroethylene - Regulatory level: 0.5 mg/L (TCLP-40 CFR 261 Appendix II) materials which contain the above substance at or above the TCLP regulatory level meet the EPA toxicity characteristic, and must be disposed of in accordance with 40 CFR part 262. EPA Hazardous Waste Number D040.

US EPA RCRA Hazardous Waste Number: RCRA U228

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Trichloroethylene-UN 1710

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
6.1 - Poisonous materials

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG III

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Keep away from food

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.153
NON-BULK PACKAGING: 49 CFR 173.203
BULK PACKAGING: 49 CFR 173.241

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 60 L
CARGO AIRCRAFT ONLY: 220 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
TRICHLOROETHYLENE		100 pounds RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
TRICHLOROETHYLENE		
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	Y	

TRICHLOROETHYLENE

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MSDS: TRITIATED WATER

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 14940-65-9

SUBSTANCE: TRITIATED WATER

TRADE NAMES/SYNONYMS:
WATER-T2; WATER, HEAVY (T2O); HEAVY WATER (T2O); TRITIUM OXIDE; TRITIUM OXIDE-T2; TRITIUM OXIDE (T2O); TRITIUM WATER; WATER (T2O); OT2; OHS24509

CHEMICAL FAMILY:
Radioactive

Oxide

CREATION DATE: 02/27/91 REVISION DATE: 04/01/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

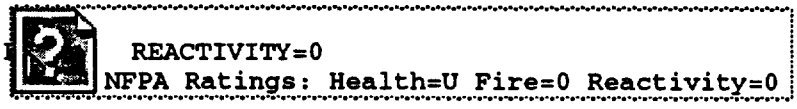
COMPONENT : TRITIATED WATER
CAS NUMBER: 14940-65-9
PERCENTAGE: 100.0

OTHER CONTAMINANTS: NONE

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=U



EMERGENCY OVERVIEW:

Liquid.
Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause nausea, vomiting, diarrhea, drowsiness, twitching, sterility, blood disorders, convulsions and shock.
LONG TERM EFFECTS: In addition to effects from short term exposure, cataracts may occur.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause redness of the skin, blisters and hair loss.
LONG TERM EFFECTS: In addition to effects from short term exposure, redness and swelling of the skin and rash may occur.
EYE CONTACT:
SHORT TERM EFFECTS: May cause redness and swelling of the eyes and eye damage.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: No information available on significant adverse effects.
LONG TERM EFFECTS: No information available on significant adverse effects.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to a restricted area with fresh air as quickly as possible. If breathing has stopped, perform artificial respiration by administering oxygen; mouth-to-mouth resuscitation should be avoided to prevent exposure to the person rendering first aid. Any evidence of serious contamination indicates that treatment must be instituted. (Inhalation of radioactive particles may indicate that other parts of the body were also contaminated, such as the digestive tract, skin and eyes.) If time permits, wipe the face with wet filter paper, force coughing and blowing of the nose. Get medical attention immediately. The victim may be contaminated with radioactive particles. Thorough decontamination should be started before the victim is moved to the medical area. Any personnel involved in rendering first aid must be monitored for radioactivity and throughly decontaminated if necessary (IAEA #3, pg.65).

SKIN CONTACT:
FIRST AID- Remove victim to a suitable area for decontamination as quickly as possible. Remove clothing and shoes immediately. Thoroughly wash the victim with soap and water, paying particular attention to the head, finger nails and palms of the hands. Upon completion of washing, monitor the victim for radioactivity. It is imperative that the skin should be decontaminated as quickly as possible. Minute skin injuries greatly increase the danger of isotope penetration into the victim; shaving should not be attempted. If water and soap have been inadequate in removing

the radioactive compound, decontaminating compounds consisting of surfactants and absorbent substances may be effective. Complexing reagents may also be of use. The use of organic solvents is to be avoided, as they may increase the solubility and absorption of the radioactive substance. Skin contamination with radiation may be an indication that other parts of the body have been exposed. Contaminated clothing must be stored in a metal container for later decontamination or disposal. The water used to wash the victim must be stored in metal containers for later disposal. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary (IAEA #47, pg.9; IAEA #3, pg.62).

EYE CONTACT:
FIRST AID- Remove victim to a restricted area for decontamination. Thoroughly wash eyes with large amounts of water, occasionally lifting the the upper and lower lids (approximately 15 minutes). Following the water treatment, provide an isotonic solution. Do not use eyebaths, rather provide a continuous and copious supply of fluid. Monitor the victim for radioactivity. If activity is present, rewash the eyes, and remonitor until little or no radioactivity is present. Get medical attention immediately. Any water used to wash the victims eyes must be stored in a metal container for later disposal. Any other articles that are used to decontaminate the victim must also be stored in metal containers for later decontamination or disposal. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary (IAEA #3, pg.65; IAEA # 47, pg. 35).

INGESTION:
FIRST AID- In the case of ingestion of radioactive substances, the mouth should be rinsed out immediately after the accident, care being taken not to swallow the water used for this purpose. Vomiting should be induced either mechanically, or with syrup of ipecac. Do not induce vomiting in an unconscious person. Lavage may be useful. Care should be taken to avoid aspiration. The vomitus and lavage fluids should be saved for examination and monitoring. Further action depends on the nature of the radioactive substance. Get medical attention immediately. The gastric fluids and fluids used for lavage must be stored in metal containers for later disposal. The victim must be monitored for radioactivity and decontaminated, if necessary, before being transported to a medical facility. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary (IAEA #47, pg.9; IAEA #3, pp. 59,66).

NOTE TO PHYSICIAN
ANTIDOTE:
TRITIUM POISONING:
No specific antidote recommended. Treatment by increasing liquid intake and by promoting diuresis has been indicated. It is possible to reduce the biological half-life from 10 days to 2.4 days simply by increasing the consumption of drinking water. The addition of diuretics may be indicated, but the risks and contraindictions of the therapy should be kept in mind. In the event of massive contamination, there might be a need for special treatment such as peritoneal dialysis or treatment with an artificial kidney. (IAEA Safety Series #47 Recommendations 1978). Treatment should be administered by qualified medical personnel.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Negligible fire hazard when exposed to heat or flame.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam
(1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray or fog (flooding amounts)
(1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Do not move damaged containers; move undamaged containers out of fire zone.
(1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 63).

Contact the local, state, or Department of Energy radiological response team. Extinguish using agents suitable for type of surrounding fire. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing dusts or vapors, keep upwind. Keep unnecessary people out of area until declared safe by radiological response team.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Radioactive decay emits low energy beta particles.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Do not touch damaged containers or spilled material. Slightly damaged or damp outer surfaces seldom indicate failure of inner container. For small liquid spills, take up with sand, earth or other noncombustible absorbent material. Dike to collect fire control water. Keep unnecessary people at least 150 feet upwind; greater distances may be necessary for people downwind or if advised by radiation authority. Isolate hazard area and deny entry. Uninjured persons or equipment with suspected contamination should be detained or isolated. Delay cleanup until arrival or instruction of radiation authority. Priority response actions may be perfomed before taking radioactive measurements--these actions include life saving, control of fire and other hazards, and first aid.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 10 CFR 20.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
Occupational exposure to radioactive substances must adhere to standards established by the Occupational Safety and Health Administration, 29 CFR 1910.96, and/or the Nuclear Regulatory Commission, 10 CFR part 20.

VENTILATION:
Provide local exhaust or process enclosure ventilation system.

One method of controlling external radiation exposure is to provide adequate shielding. The absorbing material used and the thickness required to attenuate the radiation to acceptable levels depends on the type of radiation, its energy, the flux and the dimensions of the source.
Alpha particles- for the energy range of alpha particles usually encountered, a fraction of a millimeter of any ordinary material is sufficient for absorbance. Thin rubber, acrylic, stout paper, or cardboard will suffice.
Beta particles- beta particles are more penetrating than alpha, and require more sheilding. Materials composed mostly of elements of low atomic number such as acrylic, aluminum and thick rubber are most appropriate for the absorption of beta particles. For example, 1/4 inch of acrylic will absorb all beta particles up to 1 MeV. With high energy beta radiation from large sources, Bremsstrahlung (X ray production) contribution may become significant and it may be necessary to provide additional sheilding of high atomic weight material, such as lead, to attenuate the Bremsstrahlung radiation.
Gamma rays- the most suitable materials for shielding gamma radiation are lead and iron. The thickness required will depend on whether the source is producing narrow or broad beam radiation. Primary and secondary protective barriers may be required to block all radiation.

EYE PROTECTION:
Employee must wear appropriate eye protection that will not allow the introduction of particles into the eyes. Contact lenses should not be worn.

Clothing, glove, and eye protection equipment will provide protection against alpha particles, and some protection against beta particles, depending on thickness, but will not shield gamma radiation.

CLOTHING:
Disposable overgarments, including head coverings and foot covering, should be worn by any employee engaged in handling any radiactive substance. These garments are also recommended even if the employee is working with a "glove box" containment system. Certain clothing fibers may be useful in dosimetry so clothing should be kept.
In the event of an accident, large scale release or a large scale clean-up full protective clothing will be necessary.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance. Used gloves may present a radiation hazard and should be disposed of as radioactive waste.

RESPIRATOR:
These recommended respirators should provide protection for the respiratory tract against most of the radioactive particles encountered in the work place. These respirators will not offer protection against beta and gamma radiation, but may block alpha particles. From 10CFR20.103 Appendix A. Respiratory equipment must be certified by NIOSH/MSHA.

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 continous-flow mode.

Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Liquid.
MOLECULAR WEIGHT: 22.032
MOLECULAR FORMULA: T2-O
BOILING POINT: 216 F (102 C)
FREEZING POINT: 32 F (0 C) (water)
VAPOR PRESSURE: 760 mmHg @ 100 C H2O
VAPOR DENSITY: no data available
SPECIFIC GRAVITY: 1.2138 g/cc density
WATER SOLUBILITY: not available
PH: no data available
ODOR THRESHOLD: no data available
EVAPORATION RATE: no data available
SPECIFIC ACTIVITY: 9700 Ci/g
TRITIUM HALF-LIFE: 12.26 years
TRITIUM DECAY ENERGY: 0.01861 MeV

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
Radiation hazard, do not allow material to spread or contaminate water

sources. May burn but does not ignite readily. Type B packages are designed to withstand temperatures to 1475 F (800 C).

INCOMPATIBILITIES:
TRITIATED WATER:
No data available.

HAZARDOUS DECOMPOSITION:
Radioactive decay emits low energy beta particles.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

TRITIATED WATER:
CARCINOGEN STATUS: None. However, exposure to ionizing radiation may cause cancer.
ACUTE TOXICITY LEVEL: No data available.
TARGET EFFECTS: No data available.
ADDITIONAL DATA: Tritium, with a biological half-life of approximately 10 days mixes with extracellular body water and therefore is distributed uniformly throughout the body. Tritium emits beta particles. Exposure may result in wh body radiation.

HEALTH EFFECTS
INHALATION:
TRITIATED WATER:
See information on beta radiation.

BETA RADIATION:
ACUTE EXPOSURE- Beta emitters may or may not be absorbed, depending on the solubility and particle size. Insoluble compounds and heavier particles may remain at or near the site of deposition and be brought back up the throat via ciliary action. Soluble compounds may rapidly enter the bloodstream. Lighter particles may penetrate to the alveolar sacs and remain. The damage depends on how quickly they are eliminated, and the susceptibility of the tissue in which they are stored. A single large dose may lead to radiation sickness.
CHRONIC EXPOSURE- The effects of chronic exposure by internally deposited beta radiation is dependent upon the dose and target organ(s). If the total dose is sufficient, radiation sickness may occur. Possible disorders include lung cancer, sterility, anemia, leukemia or bone cancer.

RADIATION SICKNESS:
ACUTE EXPOSURE- Whole body doses of 200-1000 rads may cause anorexia, apathy, nausea and vomiting and may become maximal within 6-12 hours. An asymptomatic period of 24-36 hours may be followed by lymphopenia and slowly developing neutropenia. Thrombocytopenia may become prominent within 3-4 weeks. The lymph nodes, spleen and bone marrow may begin to atrophy. If bone marrow depression reaches a critical level, death may occur from overwhelming infection. Whole body doses of 400 or more rads may cause intractable nausea, vomiting and diarrhea that may lead to severe dehydration, vascular collapse and death. Regeneration of the

intestinal epithelium may occur, but may be followed by hematopoietic failure within 2-3 weeks. Whole body doses of 600 or more rads may be fatal due to gastrointestinal or hematopoietic malfunction. With doses <600 rads, the possibility of survival is inversely related to the dose. Whole body doses >3000 rads generally cause nausea, vomitng, listlessness, drowsiness ranging from apathy to prostration, tremors, convulsions, ataxia and death within a few hours. The gonads are also particularly radiosensitive. A single dose of 30 rads results in temporary sterility among men. In women, loss of fertility may be indicated by loss of menstruation.

CHRONIC EXPOSURE- The delayed effects of radiation may be due either to a single large overexposure or continuing low-level overexposure and may include cancer, genetic effects, shortening of life span and cataracts. Cancer is observed most frequently in the hematopoietic system, thyroid, bone and skin. Leukemia is among the most likely forms of malignancy. Lung cancer may also occur due to radioactive materials residing in the lungs. Genetic effects may range from point mutations to severe chromosome damage such as strand breakage, translocations, and deletions. If the germ cells have been affected, the effects of the mutation may not become apparent until the next generation, or even later.

SKIN CONTACT:
TRITIATED WATER:
See information on beta radiation.

BETA RADIATION:

ACUTE EXPOSURE- Contact may cause erythema, changes in pigmentation, epilation, blistering, necrosis, and ulceration. The skin is also subject to cancer formation after relatively severe skin damage. The effects may be worse at the site of a wound. Absorption or penetration through damaged skin may result in radiation sickness.

CHRONIC EXPOSURE- Small repeated doses may cause dermatitis. The hands may become dry and violet-red. Alopecia and urticaria may occur. The skin may become thin. In advanced cases, keratoses and warts may be formed, between which the skin may crack easily. Prolonged or repeated exposure may result in radiation sickness.

RADIATION SICKNESS:
The clinical course of radiation sickness depends upon the dose, dose rate, area of the body affected and time after exposure. External and internal radioactivity of any type may cause radiation sickness.
Radiation sickness may cause effects consisting of three (3) clearly defined syndromes which are described in detail in the inhalation section.

EYE CONTACT:
TRITIATED WATER:
See information on beta radiation.

BETA RADIATION:

ACUTE EXPOSURE- Exposure of the eye to beta emission may result in cornea and conjunctiva inflammation. The most sensitive part of the eye is the crystalline lens. A late effect of eye irradiation is cataract formation. It may begin anywhere from 6 months to several years after exposure. The cataracts begin at the posterior pole of the lens, and continue until the entire lens has been affected. Growth of the opacity may stop at any point. The rate of growth and the degree of opacity are dependent upon the dose of radiation.

CHRONIC EXPOSURE- Repeated or prolonged exposure to beta emission may cause cataracts, as discussed above. Of the well-documented late effects of radiation on man, leukemia and cataract formation have been observed at lower doses than those required to cause skin scarring, cancer, and bone

tumors. The lens of the eye should be considered to be a critical organ.

RADIATION SICKNESS:
The eyes are very radiosensitive; a single dose of 100 rads may cause conjunctivitis and keratitis.
It is unlikely that a dose sufficient to cause radiation sickness would occur if only the eyes were irradiated. However, if eye damage by ionizing radiation occurs, it may be best to assume that other parts of the body have also been contaminated. Radiation sickness may cause effects as described in the inhalation section.

INGESTION:
TRITIATED WATER:
Generational studies indicate a reduction in litter size in progressive generations. See information on beta radiation.

BETA RADIATION:
ACUTE EXPOSURE- The fate of beta emitters depends on their physical and biological half-life. Ingestion may lead radiation sickness.
CHRONIC EXPOSURE- Repeated ingestion of beta emitters may lead to radiation sickness.

RADIATION SICKNESS:
The symptoms of radiation sickness depends upon the dose received. It may result from acute or chronic exposure to any form of radiation. The symptoms are described in the inhalation section.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with 10 CFR 20 and 60.

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Radioactive material, n.o.s. (tritiated water)-UN 2982

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
7 - Radioactive material

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101
AND SUBPART E:
Radioactive

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.421 and 49 CFR 173.428
NON-BULK PACKAGING: 49 CFR 173.415 and 49 CFR 173.416
BULK PACKAGING: 49 CFR 173.415 and 49 CFR 173.416

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: N

CERCLA SECTION 103 (40CFR302.4):	N
SARA SECTION 302 (40CFR355.30):	N
SARA SECTION 304 (40CFR355.40):	N
SARA SECTION 313 (40CFR372.65):	N
OSHA PROCESS SAFETY (29CFR1910.119):	N
CALIFORNIA PROPOSITION 65:	N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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MSDS: XYLENE

SECTION 1

CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 1330-20-7
RTECS NUMBER: ZE2100000

SUBSTANCE: XYLENE

TRADE NAMES/SYNONYMS:
BENZENE, DIMETHYL-; DILAN; DIMETHYLBENZENE; XYLOL;
HUMISEAL THINNER NO.33 (HUMISEAL DIV.);
HUMISEAL THINNER NO.SP 420 (HUMISEAL DIV.);
SOLVESSO XYLENE (HUMBLE OIL AND REFINING COMPANY);
TT-X-9166 REDUCER (ADVANCED COATINGS AND CHEMICALS);
DYNACHEM (R) DEVELOPER DCR (THIOKOL/DYNACHEM CORPORATION);
THINNER 2000 (KOP-COAT); SOL 9050 XYLENE (CHEMTECH INDUSTRIES, INC.);
HUMISEAL THINNER NO. 521 (M.W. RIEDEL AND COMPANY);
NEGATIVE TYPE DEVELOPING SOLUTION (GC ELECTRONICS); C8H10;
ULTRADEL R750 RINSE SOLUTION; 1200 THINNER; RCRA U239; UN 1307;
STCC 4904350; OHS25150

CHEMICAL FAMILY:
Hydrocarbon, aromatic

CREATION DATE: 11/14/84 REVISION DATE: 03/06/96

SECTION 2

COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : XYLENE
CAS NUMBER: 1330-20-7
PERCENTAGE: 100

OTHER CONTAMINANTS: NONE

SECTION 3

HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2  REACTIVITY=0
NFPA Ratings: Health=2 Fire=3 Reactivity=0

EMERGENCY OVERVIEW:
Light colored or colorless mobile liquid with an aromatic odor.
Causes respiratory tract, skin, and eye irritation. May affect the central nervous system.
Flammable liquid and vapor. May cause flash fire.
Keep away from all ignition sources. Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include low body temperature, ringing in the ears, nausea, vomiting, stomach pain, difficulty speaking, headache, drowsiness, drunkenness, numbness, twitching, loss of memory, visual disturbances, lung congestion and coma.
LONG TERM EFFECTS: In addition to effects from short term exposure, tingling sensation, menstrual disorders, infertility and convulsions may occur. May also cause reproductive effects.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation. Additional effects may include blisters.
LONG TERM EFFECTS: In addition to effects from short term exposure, rash may occur.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation, possibly severe. Additional effects may include intolerance of the eyes to light.
LONG TERM EFFECTS: In addition to effects from short term exposure, blurred vision may occur.
INGESTION:
SHORT TERM EFFECTS: May cause digestive disorders, bloody vomit, drunkenness and lung congestion.
LONG TERM EFFECTS: May cause reproductive effects.
ADDITIONAL DATA: Drinking alcohol may worsen the effects.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4

FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:
FIRST AID- Extreme care must be used to prevent aspiration. Gastric lavage with a cuffed endotracheal tube in place to prevent further aspiration should be done within 15 minutes. In the absence of depression or convulsions or impaired gag reflex, emesis can also be induced using syrup of ipecac without increasing the hazard of aspiration (Dreisbach, Handbook of Poisoning, 12th Ed.). Treat symptomatically and supportively. Gastric lavage should be performed by qualified medical personnel. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5

FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Dangerous fire hazard when exposed to heat or flame.

Due to low electroconductivity of the substance, flow or agitation may generate electrostatic charges resulting in sparks with possible ignition.

Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.

Vapor-air mixtures are explosive.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 27).

Extinguish only if flow can be stopped; use water in flooding amounts as fog, solid streams may spread fire. Cool containers with flooding quantities of water, apply from as far a distance as possible. Avoid breathing toxic vapors, keep upwind.

Water may be ineffective. (NFPA 325, Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids, 1994).

FLASH POINT: 81-90 F (27-32 C) (CC)
LOWER FLAMMABLE LIMIT: 1.0%
UPPER FLAMMABLE LIMIT: 7.0%
AUTOIGNITION: 867-984 F (464-529 C)
FLAMMABILITY CLASS(OSHA): IC

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of carbon.

SECTION 6

ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Stop leak if you can do it without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area. Keep unnecessary people away; isolate hazard area and restrict entry.

Reportable Quantity (RQ): 1000 pounds
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SOIL SPILL:
Dig a holding area such as a pit, pond or lagoon to contain spill and dike surface flow using barrier of soil, sandbags, foamed polyurethane or foamed concrete. Absorb liquid mass with fly ash or cement powder.

Immobilize spill with universal gelling agent.

Reduce vapor and fire hazard with appropriate foam.

AIR SPILL:
Knock down vapors with water spray. Keep upwind.

WATER SPILL:
Limit spill motion and dispersion with natural barriers or oil spill control booms.

Apply detergents, soaps, alcohols or another surface active agent.

Apply universal gelling agent to immobilize trapped spill and increase efficiency of removal.

If dissolved, at a concentration of 10 ppm or greater, apply activated carbon at ten times the amount that has been spilled.

Use suction hoses to remove trapped spill material.

Use mechanical dredges or lifts to extract immobilized masses of pollution and precipitates.

SECTION 7

HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 29 CFR 1910.106.

Bonding and grounding: Substances with low electroconductivity, which may be ignited by electrostatic sparks, should be stored in containers which meet the bonding and grounding guidelines specified in NFPA 77-1983, Recommended Practice on Static Electricity.

Protect against physical damage. Outside or detached storage is preferable. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials (NFPA 49, hazardous chemicals data, 1975).

Store away from incompatible substances.

SECTION 8

EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
XYLENE:
100 ppm (434 mg/m3) OSHA TWA;
150 ppm (651 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
100 ppm (434 mg/m3) ACGIH TWA; 150 ppm (651 mg/m3) ACGIH STEL
ACGIH A4-Not Classifiable as a Human Carcinogen (Proposed Addition 1995-96)
100 ppm (434 mg/m3) NIOSH recommended 10 hour TWA;
150 ppm (651 mg/m3) NIOSH recommended STEL
100 ppm (434 mg/m3) DFG MAK TWA;
200 ppm (868 mg/m3) DFG MAK 30 minute peak, average value, 4 times/shift

Measurement method: Charcoal tube; carbon disulfide; gas chromatography with flame ionization detection; (NIOSH III # 1501, Aromatic Hydrocarbons).

100 pounds CERCLA Section 103 Reportable Quantity
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting

VENTILATION:
Provide local exhaust or general dilution ventilation to meet published exposure limits. Ventilation equipment should be explosion-proof if explosive

concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles to prevent eye contact with this substance.

Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent repeated or prolonged skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

XYLENE (O-, M-, AND P-ISOMERS):
900 ppm- Any chemical cartridge respirator with organic vapor cartridge(s).
Any powered, air-purifying respirator with organic vapor cartridge(s).
Any supplied-air respirator.
Any self-contained breathing apparatus with a full facepiece.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

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 self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Light colored or colorless mobile liquid with an aromatic odor.
MOLECULAR WEIGHT: 106.16
MOLECULAR FORMULA: C6-H4-(C-H3)2

BOILING POINT: 280-291 F (138-144 C)
FREEZING POINT: -54-55 F (-48-13 C)
VAPOR PRESSURE: 7-9 mmHg @ 20 C
VAPOR DENSITY: 3.7
SPECIFIC GRAVITY: 0.8611-0.8802
WATER SOLUBILITY: 0.00003%
VOLATILITY: 100%
PH: no data available
ODOR THRESHOLD: 0.3 ppm
EVAPORATION RATE: (butyl acetate=1) 0.6
SOLVENT SOLUBILITY: Soluble in alcohol, ether, acetone, petroleum ether, benzene, carbon tetrachloride, organic solvents.

SECTION 10

STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
Avoid contact with heat, sparks, flames, or other sources of ignition. Vapors may be explosive. Avoid overheating of containers; containers may violently rupture in heat of fire. Avoid contamination of water sources.

INCOMPATIBILITIES:
XYLENE:
  NITRIC ACID: Exothermic reaction.
  OXIDIZERS (STRONG): Fire and explosion hazard.
  PLASTICS, RUBBER, COATINGS: May be attacked.
  SULFURIC ACID: Exothermic reaction.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of carbon.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11

TOXICOLOGICAL INFORMATION

XYLENE:
IRRITATION DATA: 200 ppm eye-human; 87 mg eye-rabbit mild; 5 mg/24 hours eye-rabbit severe; 100% skin-rabbit moderate; 500 mg/24 hours skin-rabbit moderate.
TOXICITY DATA: 10000 ppm/6 hours inhalation-man LCLo; 200 ppm inhalation-human TCLo; 5000 ppm/4 hours inhalation-rat LC50; 450 ppm inhalation-guinea pig LCLo; 30 gm/m3 inhalation-mammal LC50; 1600 ppm/20 hours/7 days-intermittent inhalation-rat TCLo; >1700 mg/kg skin-rabbit LD50; 50 mg/kg oral-human LDLo; 4300 mg/kg oral-rat LD50; 6 gm/kg oral-mouse LDLo; 4300 mg/kg oral-mammal LD50; 28 gm/kg/14 days-continuous oral-rat TDLo; 28 gm/kg/14 days-continuous

oral-mouse TDLo; 63 gm/kg/90 days-intermittent oral-rat TDLo; 1700 mg/kg subcutaneous-rat LD50; 129 mg/kg intravenous-rabbit LDLo; 2 gm/kg intraperitoneal-mammal LDLo; 2459 mg/kg intraperitoneal-rat LD50; 1548 mg/kg intraperitoneal-mouse LD50; 2 gm/kg intraperitoneal-guinea pig LDLo; 12740 ug/kg/30 days-intermittent intraperitoneal-rat TDLo; 4128 mg/kg/3 days-intermittent intraperitoneal-rat TDLo; reproductive effects data (RTECS), (DPIRDU), (85IFAI), (38MKAJ).

CARCINOGEN STATUS: Human Inadequate Evidence, Animal Inadequate Evidence, (IARC Group-3).

LOCAL EFFECTS: Irritant- inhalation, skin, eye.

ACUTE TOXICITY LEVEL: Moderately toxic by inhalation, dermal absorption and ingestion.

TARGET EFFECTS: Central nervous system depressant. Poisoning may also affect the nervous system, liver and kidneys.

ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine or ephedrine may induce ventricular fibrillation.

HEALTH EFFECTS

INHALATION:

XYLENE:

IRRITANT/NARCOTIC. 900 ppm Immediately Dangerous to Life or Health.

ACUTE EXPOSURE- Irritation of the upper respiratory tract may occur at 200 ppm. Exposure to higher concentrations may cause more severe irritation and initial central nervous system excitation followed by depression. Signs and symptoms may include respiratory difficulty and substernal pain, transient euphoria and emotional lability, headache, nausea, vomiting, anorexia, abdominal pain, dizziness, drowsiness, ataxia, and staggering. There may be salivation, slurred speech, blurred vision, nystagmus, tinnitus, tremors, confusion, and flushing of the face and a feeling of increased body heat. In severe exposures, there may be stupor, anesthesia, unconsciousness, and coma which may be punctuated by episodes of neuroirritability, but rarely frank convulsions, except in terminal asphyxia. Liver and kidney damage may occur, but are usually mild and transient. A group of subjects who inhaled 12.3 umol/L of xylene while exercising became significantly impaired on 3 neuropsychological tests. Exposure of 3 painters to approximately 10,000 ppm for 18.5 hours resulted in 1 death from pulmonary edema and petechial brain hemorrhage. Both survivors were unconscious for 19-24 hours and experienced retrograde amnesia, hypothermia, and lung congestion. Renal and hepatic impairment also developed. Complete recovery took 15 days. High concentrations may cause death from sudden ventricular fibrillation, but more frequently death occurs from respiratory arrest.

CHRONIC EXPOSURE- Repeated or prolonged inhalation of vapors above 200 ppm may cause nausea, vomiting, abdominal pain, and anorexia. Other common complaints include headache, fatigue, lassitude, irritability, breathing difficulties, and flatulence. Effects on the nervous system may result in excitation, followed by depression, paresthesias, tremors, apprehension, impaired memory, insomnia, vertigo, and tinnitus. Effects on reaction time, manual coordination, body balance and EEG occurred with repeated exposure to 90 ppm of m-xylene. Sweetish taste in the mouth, dry nose and throat, strong thirst, mucosal hemorrhage, and anemia have been reported. Effects on the liver, kidney, cardiovascular system, and the bone marrow have also been reported, although the latter has been questioned. Exposure of rabbits to 1150 ppm for 40-55 days resulted in a reversible decrease in the red and white cell counts and an increase in the platelets. One case of an apparent epileptiform seizure following a relatively brief exposure has occurred. Women may develop menstrual disorders, such as menorrhagia or metrorrhagia, infertility, and pathological pregnancy conditions including toxicosis, danger of miscarriage, and hemorrhaging during delivery. Repeated exposure of pregnant mice, rats and rabbits to the individual or the mixed isomers has resulted in maternal effects and

effects on fertility, on the embryo or fetus, and specific developmental abnormalities. Included among these effects are fetal death, fetotoxicity, pre- and post-implantation mortality, abortion, craniofacial and musculoskeletal abnormalities, and extra embryonic structures.

SKIN CONTACT:
XYLENE:
IRRITANT.
ACUTE EXPOSURE- Liquid xylene is a defatting agent and may cause a burning sensation, drying, vasodilation, erythema, and possibly blistering. The liquid is readily absorbed through intact or broken skin at a rate of approximately 4-10 mg/cm2/hour, but systemic effects have not been reported.
CHRONIC EXPOSURE- Repeated or prolonged contact may cause defatting of the skin with drying, erythema, cracking, thickening and blistering. Repeated application of 95% xylene to rabbit skin caused moderate to marked irritation with erythema and moderate necrosis. One case of allergic contact urticaria has been reported.

EYE CONTACT:
XYLENE:
IRRITANT.
ACUTE EXPOSURE- 200 ppm has caused conjunctival irritation in humans; at higher concentrations, irritation may be severe. Vapor exposure has also caused tearing and photophobia. An accidental splash in the human eye caused transient superficial damage with rapid recovery, although reversible corneal burns have also been reported.
CHRONIC EXPOSURE- Repeated or prolonged exposure to high vapor concentrations may cause a burning sensation, conjunctivitis and blurred vision; reversible vacuolar, epithelial keratopathy has been reported in some workers.

INGESTION:
XYLENE:
NARCOTIC.
ACUTE EXPOSURE- May cause a burning sensation in the mouth and stomach, salivation, severe gastrointestinal distress with nausea and vomiting, possibly hematemesis, and toxic effects including signs of central nervous system depression and other symptoms as in acute inhalation, including ventricular fibrillation and liver and kidney injury. Ingestion of small quantities of 90% xylene plus toluene produced urinary dextrose and urobilinogen excretion with toxic hepatitis, which was reversible in 20 days. A dose of 15-30 milliliters (about 1/2-1 ounce) is the expected human lethal dose. With aspiration of even a few milliliters into the lungs, severe coughing, distress, chemical pneumonitis, rapidly developing pulmonary edema, and hemorrhage may occur.
CHRONIC EXPOSURE- No data available on the ortho-isomer. Repeated ingestion of the mixed, meta-, or para-isomers by pregnant mice resulted in effects on fertility, on the embryo or fetus, or specific developmental abnormalities. Included among these effects were fetotoxicity, litter size, craniofacial and musculoskeletal system abnormalities, and post-implantation mortality.

SECTION 12

ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13

DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40CFR 262. EPA Hazardous Waste Number U239.

US EPA RCRA Hazardous Waste Number: RCRA U239

SECTION 14

TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Xylenes-UN 1307

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
3 - Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 5 L
CARGO AIRCRAFT ONLY: 60 L

SECTION 15

REGULATORY INFORMATION

TSCA INVENTORY STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	
XYLENE		100 pounds RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
XYLENE		
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	N	

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	Y
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16

OTHER INFORMATION

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Appendix D

Trench and Excavation Safety

(2) Decks and other working surfaces shall be maintained in a safe condition.

(3) Employees shall not be permitted to pass fore and aft, over, or around deckloads, unless there is a safe passage.

(4) Employees shall not be permitted to walk over deckloads from rail to coaming unless there is a safe passage. If it is necessary to stand at the outboard or inboard edge of the deckload where less than 24 inches of bulwark, rail, coaming, or other protection exists, all employees shall be provided with a suitable means of protection against falling from the deckload.

(d) *First-aid and lifesaving equipment.* (1) Provisions for rendering first aid and medical assistance shall be in accordance with Subpart D of this part.

(2) The employer shall ensure that there is in the vicinity of each barge in use at least one U.S. Coast Guard-approved 30-inch lifering with not less than 90 feet of line attached, and at least one portable or permanent ladder which will reach the top of the apron to the surface of the water. If the above equipment is not available at the pier, the employer shall furnish it during the time that he is working the barge.

(3) Employees walking or working on the unguarded decks of barges shall be protected with U.S. Coast Guard-approved work vests or buoyant vests.

(e) *Commercial diving operations.* Commercial diving operations shall be subject to Subpart T of Part 1910, §§ 1910.401-1910.441, of this chapter.

[39 FR 22801, June 24, 1974, as amended at 42 FR 37674, July 22, 1977]

§ 1926.606 Definitions applicable to this subpart.

(a) "Apron"—The area along the waterfront edge of the pier or wharf.

(b) "Bulwark"—The side of a ship above the upper deck.

(c) "Coaming"—The raised frame, as around a hatchway in the deck, to keep out water.

(d) "Jacob's ladder"—A marine ladder of rope or chain with wooden or metal rungs.

(e) "Rail", for the purpose of § 1926.605, means a light structure serving as a guard at the outer edge of a ship's deck.

Subpart P—Excavations, Trenching, and Shoring

§ 1926.650 General protection requirements.

(a) Walkways, runways, and sidewalks shall be kept clear of excavated material or other obstructions and no sidewalks shall be undermined unless shored to carry a minimum live load of one hundred and twenty-five (125) pounds per square foot.

(b) If planks are used for raised walkways, runways, or sidewalks, they shall be laid parallel to the length of the walk and fastened together against displacement.

(c) Planks shall be uniform in thickness and all exposed ends shall be provided with beveled cleats to prevent tripping.

(d) Raised walkways, runways, and sidewalks shall be provided with plank steps on strong stringers. Ramps, used in lieu of steps, shall be provided with cleats to insure a safe walking surface.

(e) All employees shall be protected with personal protective equipment for the protection of the head, eyes, respiratory organs, hands, feet, and other parts of the body as set forth in Subpart E of this part.

(f) Employees exposed to vehicular traffic shall be provided with and shall be instructed to wear warning vests marked with or made of reflectorized or high visibility material.

(g) Employees subjected to hazardous dusts, gases, fumes, mists, or atmospheres deficient in oxygen, shall be protected with approved respiratory protection as set forth in Subpart D of this part.

(h) No person shall be permitted under loads handled by power shovels, derricks, or hoists. To avoid any spillage employees shall be required to stand away from any vehicle being loaded.

(i) Daily inspections of excavations shall be made by a competent person. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary

precautions have been taken to safeguard the employees.

§ 1926.651 Specific excavation requirements.

(a) Prior to opening an excavation, effort shall be made to determine whether underground installations; i.e., sewer, telephone, water, fuel, electric lines, etc., will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such an installation, the exact location shall be determined and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation.

(b) Trees, boulders, and other surface encumbrances, located so as to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operations, shall be removed or made safe before excavating is begun.

(c) The walls and faces of all excavations in which employees are exposed to danger from moving ground shall be guarded by a shoring system, sloping of the ground, or some other equivalent means.

(d) Excavations shall be inspected by a competent person after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins shall be increased if necessary.

(e) The determination of the angle of repose and design of the supporting system shall be based on careful evaluation of pertinent factors such as: Depth of cut; possible variation in water content of the material while the excavation is open; anticipated changes in materials from exposure to air, sun, water, or freezing; loading imposed by structures, equipment, overlying material, or stored material; and vibration from equipment, blasting, traffic, or other sources.

(f) Supporting systems; i.e., piling, cribbing, shoring, etc., shall be designed by a qualified person and meet accepted engineering requirements. When tie rods are used to restrain the top of sheeting or other retaining systems, the rods shall be securely anchored well back of the angle of repose. When tight sheeting or sheet piling is used, full loading due to ground water table shall be assumed, unless prevented by weep holes or drains or other means. Additional stringers, ties, and bracing shall be provided to allow for any necessary temporary removal of individual supports.

(g) All slopes shall be excavated to at least the angle of repose except for areas where solid rock allows for line drilling or presplitting.

(h) The angle of repose shall be flattened when an excavation has water conditions, silty materials, loose boulders, and areas where erosion, deep frost action, and slide planes appear.

(i)(1) In excavations which employees may be required to enter, excavated or other material shall be effectively stored and retained at least 2 feet or more from the edge of the excavation.

(2) As an alternative to the clearance prescribed in paragraph (i)(1) of this section, the employer may use effective barriers or other effective retaining devices in lieu thereof in order to prevent excavated or other materials from falling into the excavation.

(j) Sides, slopes, and faces of all excavations shall meet accepted engineering requirements by scaling, benching, barricading, rock bolting, wire meshing, or other equally effective means. Special attention shall be given to slopes which may be adversely affected by weather or moisture content.

(k) Support systems shall be planned and designed by a qualified person when excavation is in excess of 20 feet in depth, adjacent to structures or improvements, or subject to vibration or ground water.

(l) Materials used for sheeting, sheet piling, cribbing, bracing, shoring, and underpinning shall be in good serviceable condition, and timbers shall be sound, free from large or loose knots, and of proper dimensions.

(m) Special precations shall be taken in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or a fill, particularly when the separation is less than the depth of the excavation. Particular attention also shall be paid to joints and

seams of material comprising a face and the slope of such seams and joints.

(n) Except in hard rock, excavations below the level of the base of footing of any foundation or retaining wall shall not be permitted, unless the wall is underpinned and all other precautions taken to insure the stability of the adjacent walls for the protection of employees involved in excavation work or in the vicinity thereof.

(o) If the stability of adjoining buildings or walls is endangered by excavations, shoring, bracing, or underpinning shall be provided as necessary to insure their safety. Such shoring, bracing, or underpinning shall be inspected daily or more often, as conditions warrant, by a competent person and the protection effectively maintained.

(p) Diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering an excavation and to provide adequate drainage of the area adjacent to the excavation. Water shall not be allowed to accumulate in an excavation.

(q) If it is necessary to place or operate power shovels, derricks, trucks, materials, or other heavy objects on a level above and near an excavation, the side of the excavation shall be sheet-piled, shored, and braced as necessary to resist the extra pressure due to such superimposed loads.

(r) Blasting and the use of explosives shall be performed in accordance with Subpart U of this part.

(s) When mobile equipment is utilized or allowed adjacent to excavations, substantial stop logs or barricades shall be installed. If possible, the grade should be away from the excavation.

(t) Adequate barrier physical protection shall be provided at all remotely located excavations. All wells, pits, shafts, etc., shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc., shall be backfilled.

(u) If possible, dust conditions shall be kept to a minimum by the use of water, salt, calcium chloride, oil, or other means.

(v) In locations where oxygen deficiency or gaseous conditions are possible, air in the excavation shall be tested. Controls, as set forth in Subparts D and E of this part, shall be established to assure acceptable atmospheric conditions. When flammable gases are present, adequate ventilation shall be provided or sources of ignition shall be eliminated. Attended emergency rescue equipment, such as breathing apparatus, a safety harness and line, basket stretcher, etc., shall be readily available where adverse atmospheric conditions may exist or develop in an excavation.

(w) Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.

(x) Where ramps are used for employees or equipment, they shall be designed and constructed by qualified persons in accordance with accepted engineering requirements.

(y) All ladders used on excavation operations shall be in accordance with the requirements of Subpart L of this part.

§ 1926.652 Specific trenching requirements.

(a) Banks more than 5 feet high shall be shored, laid back to a stable slope, or some other equivalent means of protection shall be provided where employees may be exposed to moving ground or cave-ins. Refer to Table P-1 as a guide in sloping of banks. Trenches less than 5 feet in depth shall also be effectively protected when examination of the ground indicates hazardous ground movement may be expected.

(b) Sides of trenches in unstable or soft material, 5 feet or more in depth, shall be shored, sheeted, braced, sloped, or otherwise supported by means of sufficient strength to protect the employees working within them. See Tables P-1, P-2 (following paragraph (g) of this section).

(c) Sides of trenches in hard or compact soil, including embankments, shall be shored or otherwise supported when the trench is more than 5 feet in depth and 8 feet or more in length. In lieu of shoring, the sides of the trench

above the 5-foot level may be sloped to preclude collapse, but shall not be steeper than a 1-foot rise to each ½-foot horizontal. When the outside diameter of a pipe is greater than 6 feet, a bench of 4-foot minimum shall be provided at the toe of the sloped portion.

(d) Materials used for sheeting and sheet piling, bracing, shoring, and underpinning, shall be in good serviceable condition, and timbers used shall be sound and free from large or loose knots, and shall be designed and installed so as to be effective to the bottom of the excavation.

(e) Additional precautions by way of shoring and bracing shall be taken to prevent slides or cave-ins when excavations or trenches are made in locations adjacent to backfilled excavations, or where excavations are subjected to vibrations from railroad or highway traffic, the operation of machinery, or any other source.

(f) Employees entering bell-bottom pier holes shall be protected by the installation of a removable-type casing of sufficient strength to resist shifting of the surrounding earth. Such temporary protection shall be provided for the full depth of that part of each pier hole which is above the bell. A lifeline, suitable for instant rescue and securely fastened to a shoulder harness, shall be worn by each employee entering the shafts. This lifeline shall be individually manned and separate from any line used to remove materials excavated from the bell footing.

(g)(1) Minimum requirements for trench timbering shall be in accordance with Table P-2.

(2) Braces and diagonal shores in a wood shoring system shall not be subjected to compressive stress in excess of values given by the following formula:

$$S = 13 - 20L/D$$

Maximum ratio $L/D = 50$

Where:

L = Length, unsupported, in inches.
D = Least side of the timber in inches.
S = Allowable stress in pounds per square inch of cross-section.

Table P - 1

APPROXIMATE ANGLE OF REPOSE
FOR SLOPING OF SIDES OF EXCAVATIONS

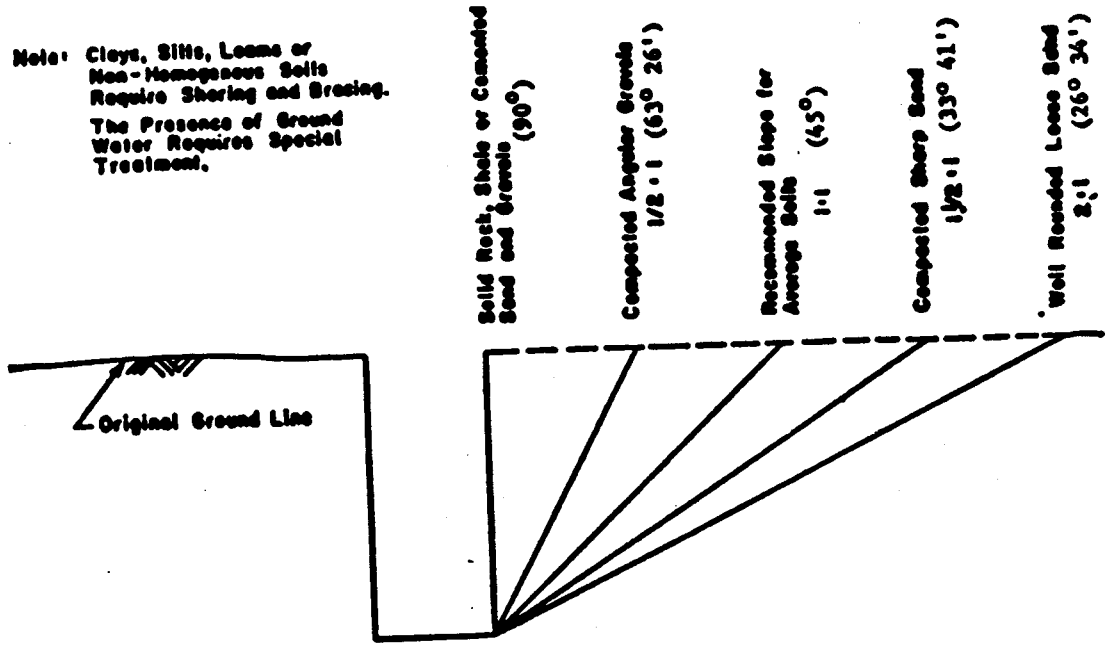

TABLE P-2—TRENCH SHORING—MINIMUM REQUIREMENTS

Depth of trench	Kind or condition of earth	Size and spacing of members										
		Uprights		Stringers		Cross braces [1]; Width of trench				Maximum spacing		
		Minimum dimension	Maximum spacing	Minimum dimension	Maximum spacing	Up to 3 feet	3 to 6 feet	6 to 9 feet	9 to 12 feet	12 to 15 feet	Vertical	Horizontal
Feet		Inches	Feet	Inches	Feet	Inches	Inches	Inches	Inches	Inches	Feet	Feet
5 to 10	Hard, compact	3×4 or 2×6	6			2×6	4×4	4×6	6×6	6×8	4	6
	Likely to crack	3×4 or 2×6	3	4×6	4	2×6	4×4	4×6	6×6	6×8	4	6
	Soft, sandy, or filled	3×4 or 2×6	Close sheeting	4×6	4	4×4	4×6	6×6	6×8	8×8	4	6
	Hydrostatic pressure	3×4 or 2×6	Close sheeting	6×8	4	4×4	4×6	6×6	6×8	8×8	4	6
10 to 15	Hard	3×4 or 2×6	4	4×6	4	4×4	4×6	6×6	6×8	8×8	4	6
	Likely to crack	3×4 or 2×6	2	4×6	4	4×4	4×6	6×6	6×8	8×8	4	6
	Soft, sandy, or filled	3×4 or 2×6	Close sheeting	4×6	4	4×6	6×6	6×8	8×8	8×10	4	6
	Hydrostatic pressure	3×6	Close sheeting	8×10	4	4×6	6×6	6×8	8×8	8×10	4	6
15 to 20	All kinds or conditions	3×6	Close sheeting	4×12	4	4×12	6×8	8×8	8×10	10×10	4	6
Over 20	All kinds or conditions	3×6	Close sheeting	6×8	4	4×12	8×8	8×10	10×10	10×12	4	6

[1] Trench jacks may be used in lieu of, or in combination with, cross braces.
Shoring is not required in solid rock, hard shale, or hard slag.
Where desirable, steel sheet piling and bracing of equal strength may be substituted for wood.

(h) When employees are required to be in trenches 4 feet deep or more, an adequate means of exit, such as a ladder or steps, shall be provided and located so as to require no more than 25 feet of lateral travel.

(i) Bracing or shoring of trenches shall be carried along with the excavation.

(j) Cross braces or trench jacks shall be placed in true horizontal position, be spaced vertically, and be secured to prevent sliding, falling, or kickouts.

(k) Portable trench boxes or sliding trench shields may be used for the protection of personnel in lieu of a shoring system or sloping. Where such trench boxes or shields are used, they shall be designed, constructed, and maintained in a manner which will provide protection equal to or greater than the sheeting or shoring required for the trench.

(l) Backfilling and removal of trench supports shall progress together from the bottom of the trench. Jacks or braces shall be released slowly and, in unstable soil, ropes shall be used to pull out the jacks or braces from above after employees have cleared the trench.

§ 1926.653 Definitions applicable to this subpart.

(a) "Accepted engineering requirements (or practices)"—Those requirements or practices which are compatible with standards required by a registered architect, a registered professional engineer, or other duly licensed or recognized authority.

(b) "Angle of repose"—The greatest angle above the horizontal plane at which a material will lie without sliding.

(c) "Bank"—A mass of soil rising above a digging level.

(d) "Belled excavation"—A part of a shaft or footing excavation, usually near the bottom and bell-shaped; i.e., an enlargement of the cross section above.

(e) "Braces (trench)"—The horizontal members of the shoring system whose ends bear against the uprights or stringers.

(f) "Excavation"—Any manmade cavity or depression in the earth's surface, including its sides, walls, or faces, formed by earth removal and producing unsupported earth conditions by reasons of the excavation. If installed forms or similar structures reduce the depth-to-width relationship, an excavation may become a trench.

(g) "Faces"—See paragraph (k) of this section.

(h) "Hard compact soil"—All earth materials not classified as running or unstable.

(i) "Kickouts"—Accidental release or failure of a shore or brace.

(j) "Sheet pile"—A pile, or sheeting, that may form one of a continuous interlocking line, or a row of timber, concrete, or steel piles, driven in close contact to provide a tight wall to resist the lateral pressure of water, adjacent earth, or other materials.

(k) "Sides", "Walls", or "Faces"—The vertical or inclined earth surfaces formed as a result of excavation work.

(l) "Slope"—The angle with the horizontal at which a particular earth material will stand indefinitely without movement.

(m) "Stringers" (wales)—The horizontal members of a shoring system whose sides bear against the uprights or earth.

(n) "Trench"—A narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench is not greater than 15 feet.

(o) "Trench jack"—Screw or hydraulic type jacks used as cross bracing in a trench shoring system.

(p) "Trench shield"—A shoring system composed of steel plates and bracing, welded or bolted together, which support the walls of a trench from the ground level to the trench bottom and which can be moved along as work progresses.

(q) "Unstable soil"—Earth material, other than running, that because of its nature or the influence of related conditions, cannot be depended upon to remain in place without extra support, such as would be furnished by a system of shoring.

(r) "Uprights"—The vertical members of a shoring system.

(s) "Wales"—See paragraph (m) of this section.

(t) "Walls"—See paragraph (k) of this section.

Appendix E

Electrical Safety

Appendix E

Environmental Restoration Division

Electrical Safety Policy

E-1. Scope

This policy applies to electrical work performed by Environmental Restoration Division (ERD) personnel on ERD projects and facilities. For the purposes of this policy, ERD personnel includes ERD employees, LLNL employees matrixed to ERD, ERD supplemental labor employees and subcontract employees. This policy is not intended to apply to Plant Engineering Construction Maintenance and Operations (M&O) personnel.

Several Laboratory policies are already in place that address the general issues of electrical safety (see reference list). ERD personnel are strongly encouraged to become familiar with and follow the policies set forth in these documents. This policy is not intended to invalidate or supersede these existing documents. Rather, this policy seeks to address certain areas of ERD operations that require particular consideration.

E-2. Areas of Consideration and Related Policies

Five specific areas of consideration have been identified. These are described below, along with their related policy statements.

E-2.1. Promotion of Safety Awareness and Safe Working Practices

A strong commitment to a safe working environment must be continually reinforced. ERD managers and supervisors must regularly promote the importance of safety awareness and safe working practices.

E-2.1.2. Policy

1. All standing meetings relating to ERD laboratory and field operations shall include a safety discussion as a permanent agenda item. A few minutes at the beginning of all such meetings shall be devoted to general safety and relevant specific safety topics.
2. Managers and supervisors involved in laboratory and field operations shall schedule periodic meetings devoted entirely to safety topics.
3. ERD personnel shall be encouraged to raise safety issues and make specific safety suggestions. The responsible manager or supervisor must address each issue raised.

E-2.2. Unfamiliar Personnel Performing Work in and Around Potentially Live Electrical Enclosures

Work is occasionally performed in and around potentially live circuits by non-ERD personnel. Typically, such work is initiated by someone within ERD.

E-2.2.1. Policy

1. Lock and tag procedures shall be carried out by a responsible ERD person, who must be up to date with Lock and Tag Procedures (HS5245). The non-ERD person who will be performing the work shall observe the lock and tag procedure, double check that power has been removed, and then apply a separate, additional lock that is under their control.

E.2.3. Installation and Wiring of Extraction Well Pumps

Non-electrical ERD personnel are sometimes required to connect an extraction well pump to a power source .

E-2.3.1. Policies

1. ERD personnel performing well pump connections must be up to date on Electrical Hazards Awareness (HS5220), Capacitor Safety (HS5210), Lock and Tag Procedure (HS5245), and Cardiopulmonary Resuscitation (HS6140).
2. If the power source is a utility-supplied AC power line, proper lock and tag procedures shall be carried out by the responsible ERD person. If the power source is a generator, the responsible ERD person shall ensure that the generator is not running, with its circuit breaker switched off, during the well pump connection.
3. Proper connections shall be verified prior to removing the lock and tag, or starting the generator. Proper grounding should receive particular scrutiny.

E-2.4. Inadequate, Obsolete, or Missing Electrical Drawings and Labels

Up to date, accurate drawings are essential to work safety assurance. Proper and accurate labeling can reduce the potential for mistakes.

E-2.4.1. Policies

1. An accurate and complete electrical drawing set shall be maintained, with a copy available at each permanent ERD location at all times.
2. All electrical circuits shall be labeled with the location and identification of its proper lock and tag circuit breaker.
3. All terminals containing voltages $\geq$ 50 V shall be labeled with a warning sign that includes an indication of the voltage present.

E-2.5. Electrical Hazards in Confined Spaces

E-2.5.1. Policies

1. ERD personnel entering the confined space vault must be up to date with Confined-Space Entry (HS4150) and must observe the requisite procedures for confined space entry. This includes a full understanding of the electrical hazards present in the vault.

2. ERD personnel shall *never* enter a confined space vault when standing water is present *unless* all electrical service to the vault has been de-energized, with the proper lock and tag procedures carried out by the responsible ERD person.

E-3. References

Electronics Engineering Department Electrical Safety Policy, LED 61-00-01-AIA, January 1, 1986.

LLNL Health and Safety Manual, Chapter 23, *Electrical Safety*, February 1996.

LLNL Health and Safety Manual, Chapter 26, *Hazards - General and Miscellaneous*, November 1992.

LLNL Health and Safety Manual, Supplement 26.13, *General Lockout and Tagout Procedure*, September 1990.

DOE Electrical Safety Guidelines, DOE/ID 10600, May 1993.

from the area to be heated to prevent ignition.

(c) Protection against toxic preservative coatings: (1) In enclosed spaces, all surfaces covered with toxic preservatives shall be stripped of all toxic coatings for a distance of at least 4 inches from the area of heat application, or the employees shall be protected by air line respirators, meeting the requirements of Subpart E of this part.

(2) In the open air, employees shall be protected by a respirator, in accordance with requirements of Subpart E of this part.

(d) The preservative coatings shall be removed a sufficient distance from the area to be heated to ensure that the temperature of the unstripped metal will not be appreciably raised. Artificial cooling of the metal surrounding the heating area may be used to limit the size of the area required to be cleaned.

Subpart K—Electrical

General

§ 1926.400 Introduction.

This subpart addresses electrical safety requirements that are necessary for the practical safeguarding of employees involved in construction work and is divided into four major divisions and applicable definitions as follows:

(a) *Installation safety requirements.* Installation safety requirements are contained in §§ 1926.402 through 1926.408. Included in this category are electrical equipment and installations used to provide electric power and light on jobsites.

(b) *Safety-related work practices.* Safety-related work practices are contained in §§ 1926.416 and 1926.417. In addition to covering the hazards arising from the use of electricity at jobsites, these regulations also cover the hazards arising from the accidental contact, direct or indirect, by employees with all energized lines, above or below ground, passing through or near the jobsite.

(c) *Safety-related maintenance and environmental considerations.* Safety-related maintenance and environmental considerations are contained in §§ 1926.431 and 1926.432.

(d) *Safety requirements for special equipment.* Safety requirements for special equipment are contained in § 1926.441.

(e) *Definitions.* Definitions applicable to this Subpart are contained in § 1926.449.

§ 1926.401 [Reserved.]

Installation Safety Requirements

§ 1926.402 Applicability.

(a) *Covered.* Sections 1926.402 through 1926.408 contain installation safety requirements for electrical equipment and installations used to provide electric power and light at the jobsite. These sections apply to installations, both temporary and permanent, used on the jobsite; but these sections do not apply to existing permanent installations that were in place before the construction activity commenced.

NOTE: If the electrical installation is made in accordance with the National Electrical Code ANSI/NFPA 70-1984, exclusive of Formal Interpretations and Tentative Interim Amendments, it will be deemed to be in compliance with §§ 1926.403 through 1926.408, except for §§ 1926.404(b)(1) and 1926.405(a)(2)(ii)(E), (F), (G), and (J).

(b) *Not covered.* Sections 1926.402 through 1926.408 do not cover installations used for the generation, transmission, and distribution of electric energy, including related communication, metering, control, and transformation installations. (However, these regulations do cover portable and vehicle-mounted generators used to provide power for equipment used at the jobsite.) See Subpart V of this Part for the construction of power distribution and transmission lines.

§ 1926.403 General requirements.

(a) *Approval.* All electrical conductors and equipment shall be approved.

(b) *Examination, installation, and use of equipment*—(1) *Examination.* The employer shall ensure that electrical equipment is free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined on the basis of the following considerations:

(i) Suitability for installation and use in conformity with the provisions of this subpart. Suitability of equipment for an identified purpose may be evidenced by listing, labeling, or certification for that identified purpose.

(ii) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided.

(iii) Electrical insulation.

(iv) Heating effects under conditions of use.

(v) Arcing effects.

(vi) Classification by type, size, voltage, current capacity, specific use.

(vii) Other factors which contribute to the practical safeguarding of employees using or likely to come in contact with the equipment.

(2) *Installation and use.* Listed, labeled, or certified equipment shall be installed and used in accordance with instructions included in the listing, labeling, or certification.

(c) *Interrupting rating.* Equipment intended to break current shall have an interrupting rating at system voltage sufficient for the current that must be interrupted.

(d) *Mounting and cooling of equipment*—(1) *Mounting.* Electric equipment shall be firmly secured to the surface on which it is mounted. Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials shall not be used.

(2) *Cooling.* Electrical equipment which depends upon the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room air flow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air. Electrical equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

(e) *Splices.* Conductors shall be spliced or joined with splicing devices designed for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be so spliced or joined as to be mechanically and electrically secure without solder and then soldered. All splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors or with an insulating device designed for the purpose.

(f) *Arcing parts.* Parts of electric equipment which in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

(g) *Marking.* Electrical equipment shall not be used unless the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified is placed on the equipment and unless other markings are provided giving voltage, current, wattage, or other ratings as necessary. The marking shall be of sufficient durability to withstand the environment involved.

(h) *Identification of disconnecting means and circuits.* Each disconnecting means required by this subpart for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. These markings shall be of sufficient durability to withstand the environment involved.

(i) *600 Volts, nominal, or less.* This paragraph applies to equipment operating at 600 volts, nominal, or less.

(l) *Working space about electric equipment.* Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

(i) *Working clearances.* Except as required or permitted elsewhere in this subpart, the dimension of the working space in the direction of access to live parts operating at 600 volts or less and likely to require examination, adjustment, servicing, or maintenance while alive shall not be less than indicated in Table K-1. In addition to the dimensions shown in Table K-1, workspace shall not be less than 30 inches (762

mm) wide in front of the electric equipment. Distances shall be measured from the live parts if they are exposed, or from the enclosure front or opening if the live parts are enclosed. Walls constructed of concrete, brick, or tile are considered to be grounded. Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts such as fuses or switches on the back and where all connections are accessible from locations other than the back.

TABLE K–1—WORKING CLEARANCES

Nominal voltage to ground	Minimum clear distance for conditions[1]		
	(a)	(b)	(c)
	Feet[2]	Feet[2]	Feet[2]
0–150	3	3	3
151–600	3	3 1/2	4

[1]Conditions (a), (b), and (c) are as follows: (a) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts. (b) Exposed live parts on one side and grounded parts on the other side. (c) Exposed live parts on both sides of the workspace [not guarded as provided in Condition (a)] with the operator between.

[2]For International System of Units (SI): one foot = 0.3048m.

(ii) *Clear spaces.* Working space required by this subpart shall not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, shall be guarded.

(iii) *Access and entrance to working space.* At least one entrance shall be provided to give access to the working space about electric equipment.

(iv) *Front working space.* Where there are live parts normally exposed on the front of switchboards or motor control centers, the working space in front of such equipment shall not be less than 3 feet (914 mm).

(v) *Headroom.* The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers shall be 6 feet 3 inches (1.91 m).

(2) *Guarding of live parts.*—(i) Except as required or permitted elsewhere in this subpart, live parts of electrical equipment operating at 50 volts or more shall be guarded against accidental contact by cabinets or other forms of enclosures, or by any of the following means:

(A) By location in a room, vault, or similar enclosure that is accessible only to qualified persons.

(B) By partitions or screens so arranged that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them.

(C) By location on a balcony, gallery, or platform so elevated and arranged as to exclude unqualified persons.

(D) By elevation of 8 feet (2.44 m) or more above the floor or other working surface and so installed as to exclude unqualified persons.

(ii) In locations where electric equipment would be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.

(iii) Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

(j) *Over 600 volts, nominal.*—(1) *General.* Conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all applicable provisions of paragraphs (a) through (g) of this section and with the following provisions which supplement or modify those requirements. The provisions of paragraphs (j)(2), (j)(3), and (j)(4) of this section do not apply to equipment on the supply side of the service conductors.

(2) *Enclosure for electrical installations.* Electrical installations in a vault, room, closet or in an area surrounded by a wall, screen, or fence, access to which is controlled by lock and key or other equivalent means, are considered to be accessible to qualified persons only. A wall, screen, or fence less than 8 feet (2.44 m) in height is not considered adequate to prevent access unless it has other features that provide a degree of isolation equivalent to an 8-foot (2.44-m) fence. The entrances to all buildings,

rooms or enclosures containing exposed live parts or exposed conductors operating at over 600 volts, nominal, shall be kept locked or shall be under the observation of a qualified person at all times.

(i) *Installations accessible to qualified persons only.* Electrical installations having exposed live parts shall be accessible to qualified persons only and shall comply with the applicable provisions of paragraph (j)(3) of this section.

(ii) *Installations accessible to unqualified persons.* Electrical installations that are open to unqualified persons shall be made with metal-enclosed equipment or shall be enclosed in a vault or in an area, access to which is controlled by a lock. Metal-enclosed switchgear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment shall be marked with appropriate caution signs. If equipment is exposed to physical damage from vehicular traffic, guards shall be provided to prevent such damage. Ventilating or similar openings in metal-enclosed equipment shall be designed so that foreign objects inserted through these openings will be deflected from energized parts.

(3) *Workspace about equipment.* Sufficient space shall be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment. Where energized parts are exposed, the minimum clear workspace shall not be less than 6 feet 6 inches (1.98 m) high (measured vertically from the floor or platform), or less than 3 feet (914 mm) wide (measured parallel to the equipment). The depth shall be as required in Table K-2. The workspace shall be adequate to permit at least a 90-degree opening of doors or hinged panels.

(i) *Working space.* The minimum clear working space in front of electric equipment such as switchboards, control panels, switches, circuit breakers, motor controllers, relays, and similar equipment shall not be less than specified in Table K-2 unless otherwise specified in this subpart. Distances shall be measured from the live parts if they are exposed, or from the enclosure front or opening if the live parts are enclosed. However, working space is not required in back of equipment such as deadfront switchboards or control assemblies where there are no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on de-energized parts on the back of enclosed equipment, a minimum working space of 30 inches (762 mm) horizontally shall be provided.

TABLE K-2—MINIMUM DEPTH OF CLEAR WORKING SPACE IN FRONT OF ELECTRIC EQUIPMENT

Nominal voltage to ground	Conditions[1]		
	(a)	(b)	(c)
	Feet[2]	Feet[2]	Feet[2]
601 to 2,500	3	4	5
2,501 to 9,000	4	5	6
9,001 to 25,000	5	6	9
25,001 to 75 kV	6	8	10
Above 75kV	8	10	12

[1]Conditions (a), (b), and (c) are as follows: (a) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating materials. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts. (b) Exposed live parts on one side and grounded parts on the other side. Walls constructed of concrete, brick, or tile are considered to be grounded surfaces. (c) Exposed live parts on both sides of the workspace [not guarded as provided in Condition (a)] with the operator between.

[2]For SI units: one foot = 0.3048m.

(ii) *Lighting outlets and points of control.* The lighting outlets shall be so arranged that persons changing lamps or making repairs on the lighting system will not be endangered by live parts or other equipment. The points of control shall be so located that persons are not likely to come in contact with any live part or moving part of the equipment while turning on the lights.

(iii) *Elevation of unguarded live parts.* Unguarded live parts above working space shall be maintained at elevations not less than specified in Table K-3.

TABLE K-3 ELEVATION OF UNGUARDED ENERGIZED PARTS ABOVE WORKING SPACE

Nominal voltage Between phases	Minimum elevation
601-7,500	8 feet 6 inches[1]
7,501-35,000	9 feet
Over 35kV	9 feet + 0.37 inches per kV above 35kV

[1]For SI units: one inch = 25.4 mm; one foot = 0.3048 m

(4) *Entrance and access to workspace.* At least one entrance not less than 24 inches (610 mm) wide and 6 feet 6 inches (1.98 m) high shall be provided to give access to the working space about electric equipment. On switchboard and control panels exceeding 48 inches (1.22 m) in width, there shall be one entrance at each end of such board where practicable. Where bare energized parts at any voltage or insulated energized parts above 600 volts are located adjacent to such entrance, they shall be guarded. (Information collection requirements contained in paragraphs (g) and (h) were approved by the Office of Management and Budget under control number: 1218-0130.)

§ 1926.404 Wiring design and protection.

(a) *Use and identification of grounded and grounding conductors.*—

(1) *Identification of conductors.* A conductor used as a grounded conductor shall be identifiable and distinguishable from all other conductors. A conductor used as an equipment grounding conductor shall be identifiable and distinguishable from all other conductors.

(2) *Polarity of connections.* No grounded conductor shall be attached to any terminal or lead so as to reverse designated polarity.

(3) *Use of grounding terminals and devices.* A grounding terminal or grounding-type device on a receptacle, cord connector, or attachment plug shall not be used for purposes other than grounding.

(b) *Branch circuits.*—(1) *Ground-fault protection.*—(i) *General.* The employer shall use either ground-fault circuit interrupters as specified in paragraph (b)(1)(ii) of this section or an assured equipment grounding conductor program as specified in paragraph (b)(1)(iii) of this section to protect employees on construction sites. These requirements are in addition to any other requirements for equipment grounding conductors.

(ii) *Ground-fault circuit interrupters.* All 120-volt, single-phase, 15- and 20-ampere receptacle outlets on construction sites, which are not a part of the permanent wiring of the building or structure and which are in use by employees, shall have approved ground-fault circuit interrupters for personnel protection. Receptacles on a two-wire, single-phase portable or vehicle-mounted generator rated not more than 5kW, where the circuit conductors of the generator are insulated from the generator frame and all other grounded surfaces, need not be protected with ground-fault circuit interrupters.

(iii) *Assured equipment grounding conductor program.* The employer shall establish and implement an assured equipment grounding conductor program on construction sites covering all cord sets, receptacles which are not a part of the building or structure, and equipment connected by cord and plug which are available for use or used by employees. This program shall comply with the following minimum requirements:

(A) A written description of the program, including the specific procedures adopted by the employer, shall be available at the jobsite for inspection and copying by the Assistant Secretary and any affected employee.

(B) The employer shall designate one or more competent persons (as defined in § 1926.32(f)) to implement the program.

(C) Each cord set, attachment cap, plug and receptacle of cord sets, and any equipment connected by cord and plug, except cord sets and receptacles which are fixed and not exposed to damage, shall be visually inspected before each day's use for external defects, such as deformed or missing pins or insulation damage, and for indications of possible internal damage. Equipment found damaged or defective shall not be used until repaired.

(D) The following tests shall be performed on all cord sets, receptacles which are not a part of the permanent wiring of the building or structure, and cord- and plug-connected equipment required to be grounded:

(*1*) All equipment grounding conductors shall be tested for continuity and shall be electrically continuous.

(*2*) Each receptacle and attachment cap or plug shall be tested for correct attachment of the equipment grounding conductor. The equipment grounding conductor shall be connected to its proper terminal.

(E) All required tests shall be performed:

(*1*) Before first use;

(*2*) Before equipment is returned to service following any repairs;

(*3*) Before equipment is used after any incident which can be reasonably suspected to have caused damage (for example, when a cord set is run over); and

(*4*) At intervals not to exceed 3 months, except that cord sets and receptacles which are fixed and not exposed to damage shall be tested at intervals not exceeding 6 months.

(F) The employer shall not make available or permit the use by employees of any equipment which has not met the requirements of this paragraph (b)(1)(iii) of this section.

(G) Tests performed as required in this paragraph shall be recorded. This test record shall identify each receptacle, cord set, and cord- and plug-connected equipment that passed the test and shall indicate the last date it was tested or the interval for which it was tested. This record shall be kept by means of logs, color coding, or other effective means and shall be maintained until replaced by a more current record. The record shall be made available on the jobsite for inspection by the Assistant Secretary and any affected employee.

(2) *Outlet devices.* Outlet devices shall have an ampere rating not less than the load to be served and shall comply with the following:

(i) *Single receptacles.* A single receptacle installed on an individual branch circuit shall have an ampere rating of not less than that of the branch circuit.

(ii) *Two or more receptacles.* Where connected to a branch circuit supply two or more receptacles or outlets, receptacle ratings shall conform to the values listed in Table K-4.

(iii) *Receptacles used for the connection of motors.* The rating of an attachment plug or receptacle used for cord- and plug-connection of a motor to a branch circuit shall not exceed 15 amperes at 125 volts or 10 amperes at 250 volts if individual overload protection is omitted.

(c) *Outside conductors and lamps—*(1) *600 volts, nominal, or less.* Paragraphs (c)(l)(i) through (c)(l)(iv) of this section apply to branch circuit, feeder, and service conductors rated 600 volts, nominal, or less and run outdoors as open conductors.

TABLE K–4—RECEPTACLE RATINGS FOR VARIOUS SIZE CIRCUITS

Circuit rating amperes	Receptacle rating amperes
15	Not over 15
20	15 or 20
30	30
40	40 or 50
50	50

(i) *Conductors on poles.* Conductors supported on poles shall provide a horizontal climbing space not less than the following:

(A) Power conductors below communication conductors—30 inches (762 mm).

(B) Power conductors alone or above communication conductors: 300 volts or less—24 inches (610 mm); more than 300 volts—30 inches (762 mm).

(C) Communication conductors below power conductors: with power conductors 300 volts or less—24 inches (610 mm); more than 300 volts—30 inches (762 mm).

(ii) *Clearance from ground.* Open conductors shall conform to the following minimum clearances:

(A) 10 feet (3.05 m)—above finished grade, sidewalks, or from any platform or projection from which they might be reached.

(B) 12 feet (3.66 m)—over areas subject to vehicular traffic other than truck traffic.

(C) 15 feet (4.57 m)—over areas other than those specified in paragraph (c)(l)(ii)(D) of this section that are subject to truck traffic.

(D) 18 feet (5.49 m)—over public streets, alleys, roads, and driveways.

(iii) *Clearance from building openings.* Conductors shall have a clearance of at least 3 feet (914 mm) from windows, doors, fire escapes, or similar locations. Conductors run above the top level of a window are considered to be out of reach from that window and, therefore, do not have to be 3 feet (914 mm) away.

(iv) *Clearance over roofs.* Conductors above roof space accessible to employees on foot shall have a clearance from the highest point of the roof surface of

not less than 8 feet (2.44 m) vertical clearance for insulated conductors, not less than 10 feet (3.05 m) vertical or diagonal clearance for covered conductors, and not less than 15 feet (4.57 m) for bare conductors, except that:

(A) Where the roof space is also accessible to vehicular traffic, the vertical clearance shall not be less than 18 feet (5.49 m), or

(B) Where the roof space is not normally accessible to employees on foot, fully insulated conductors shall have a vertical or diagonal clearance of not less than 3 feet (914 mm), or

(C) Where the voltage between conductors is 300 volts or less and the roof has a slope of not less than 4 inches (102 mm) in 12 inches (305 mm), the clearance from roofs shall be at least 3 feet (914 mm), or

(D) Where the voltage between conductors is 300 volts or less and the conductors do not pass over more than 4 feet (1.22 m) of the overhang portion of the roof and they are terminated at a through-the-roof raceway or support, the clearance from roofs shall be at least 18 inches (457 mm).

2 *Location of outdoor lamps.* Lamps for outdoor lighting shall be located below all live conductors, transformers, or other electric equipment, unless such equipment is controlled by a disconnecting means that can be locked in the open position or unless adequate clearances or other safeguards are provided for relamping operations.

(d) *Services*—(1) *Disconnecting means*—(i) *General.* Means shall be provided to disconnect all conductors in a building or other structure from the service-entrance conductors. The disconnecting means shall plainly indicate whether it is in the open or closed position and shall be installed at a readily accessible location nearest the point of entrance of the service-entrance conductors.

(ii) *Simultaneous opening of poles.* Each service disconnecting means shall simultaneously disconnect all ungrounded conductors.

(2) *Services over 600 volts, nominal.* The following additional requirements apply to services over 600 volts, nominal.

(i) *Guarding.* Service-entrance conductors installed as open wires shall be guarded to make them accessible only to qualified persons.

(ii) *Warning signs.* Signs warning of high voltage shall be posted where unauthorized employees might come in contact with live parts.

(e) *Overcurrent protection*—(1) *600 volts, nominal, or less.* The following requirements apply to overcurrent protection of circuits rated 600 volts, nominal, or less.

(i) *Protection of conductors and equipment.* Conductors and equipment shall be protected from overcurrent in accordance with their ability to safely conduct current. Conductors shall have sufficient ampacity to carry the load.

(ii) *Grounded conductors.* Except for motor-running overload protection, overcurrent devices shall not interrupt the continuity of the grounded conductor unless all conductors of the circuit are opened simultaneously.

(iii) *Disconnection of fuses and thermal cutouts.* Except for devices provided for current-limiting on the supply side of the service disconnecting means, all cartridge fuses which are accessible to other than qualified persons and all fuses and thermal cutouts on circuits over 150 volts to ground shall be provided with disconnecting means. The disconnecting means shall be installed so that the fuse or thermal cutout can be disconnected from its supply without disrupting service to equipment and circuits unrelated to those protected by the overcurrent device.

(iv) *Location in or on premises.* Overcurrent devices shall be readily accessible. Overcurrent devices shall not be located where they could create an employee safety hazard by being exposed to physical damage or located in the vicinity of easily ignitible material.

(v) *Arcing or suddenly moving parts.* Fuses and circuit breakers shall be so located or shielded that employees will not be burned or otherwise injured by their operation.

(vi) *Circuit breakers.* (A) Circuit breakers shall clearly indicate whether they are in the open (off) or closed (on) position.

(B) Where circuit breaker handles on

switchboards are operated vertically rather than horizontally or rotationally, the up position of the handle shall be the closed (on) position.

(C) If used as switches in 120-volt, fluorescent lighting circuits, circuit breakers shall be marked "SWD."

(2) *Over 600 volts, nominal.* Feeders and branch circuits over 600 volts, nominal, shall have short-circuit protection.

(f) *Grounding.* Paragraphs (f)(1) through (f)(11) of this section contain grounding requirements for systems, circuits, and equipment.

(1) *Systems to be grounded.* The following systems which supply premises wiring shall be grounded:

(i) *Three-wire DC systems.* All 3-wire DC systems shall have their neutral conductor grounded.

(ii) *Two-wire DC systems.* Two-wire DC systems operating at over 50 volts through 300 volts between conductors shall be grounded unless they are rectifier-derived from an AC system complying with paragraphs (f)(1)(iii), (f)(1)(iv), and (f)(1)(v) of this section.

(iii) *AC circuits, less than 50 volts.* AC circuits of less than 50 volts shall be grounded if they are installed as overhead conductors outside of buildings or if they are supplied by transformers and the transformer primary supply system is ungrounded or exceeds 150 volts to ground.

(iv) *AC systems, 50 volts to 1000 volts.* AC systems of 50 volts to 1000 volts shall be grounded under any of the following conditions, unless exempted by paragraph (f)(1)(v) of this section:

(A) If the system can be so grounded that the maximum voltage to ground on the ungrounded conductors does not exceed 150 volts;

(B) If the system is nominally rated 480Y/277 volt, 3-phase, 4-wire in which the neutral is used as a circuit conductor;

(C) If the system is nominally rated 240/120-volt, 3-phase, 4-wire in which the midpoint of one phase is used as a circuit conductor; or

(D) If a service conductor is uninsulated.

(v) *Exceptions.* AC systems of 50 volts to 1000 volts are not required to be grounded if the system is separately derived and is supplied by a transformer that has a primary voltage rating less than 1000 volts, provided all of the following conditions are met:

(A) The system is used exclusively for control circuits,

(B) The conditions of maintenance and supervision assure that only qualified persons will service the installation,

(C) Continuity of control power is required, and

(D) Ground detectors are installed on the control system.

(2) *Separately derived systems.* Where paragraph (f)(1) of this section requires grounding of wiring systems whose power is derived from generator, transformer, or converter windings and has no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system, paragraphs (f)(5) of this section shall also apply.

(3) *Portable and vehicle-mounted generators*—(i) *Portable generators.* Under the following conditions, the frame of a portable generator need not be grounded and may serve as the grounding electrode for a system supplied by the generator:

(A) The generator supplies only equipment mounted on the generator and/or cord- and plug-connected equipment through receptacles mounted on the generator, and

(B) The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.

(ii) *Vehicle-mounted generators.* Under the following conditions the frame of a vehicle may serve as the grounding electrode for a system supplied by a generator located on the vehicle:

(A) The frame of the generator is bonded to the vehicle frame, and

(B) The generator supplies only equipment located on the vehicle and/or cord- and plug-connected equipment through receptacles mounted on the vehicle or on the generator, and

(C) The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame, and

(D) The system complies with all other provisions of this section.

(iii) *Neutral conductor bonding.* A neutral conductor shall be bonded to the generator frame if the generator is a component of a separately derived system. No other conductor need be bonded to the generator frame.

(4) *Conductors to be grounded.* For AC premises wiring systems the identified conductor shall be grounded.

(5) *Grounding connections*—(i) *Grounded system.* For a grounded system, a grounding electrode conductor shall be used to connect both the equipment grounding connector and the grounded circuit conductor to the grounding electrode. Both the equipment grounding conductor and the grounding electrode conductor shall be connected to the grounded circuit conductor on the supply side of the service disconnecting means, or on the supply side of the system disconnecting means or overcurrent devices if the system is separately derived.

(ii) *Ungrounded systems.* For an ungrounded service-supplied system, the equipment grounding conductor shall be connected to the grounding electrode conductor at the service equipment. For an ungrounded separately derived system, the equipment grounding conductor shall be connected to the grounding electrode conductor at, or ahead of, the system disconnecting means or overcurrent devices.

(6) *Grounding path.* The path to ground from circuits, equipment, and enclosures shall be permanent and continuous.

(7) *Supports, enclosures, and equipment to be grounded*—(i) *Supports and enclosures for conductors.* Metal cable trays, metal raceways, and metal enclosures for conductors shall be grounded, except that:

(A) Metal enclosures such as sleeves that are used to protect cable assemblies from physical damage need not be grounded; and

(B) Metal enclosures for conductors added to existing installations of open wire, knob-and-tube wiring, and nonmetallic-sheathed cable need not be grounded if all of the following conditions are met:

(*1*) Runs are less than 25 feet (7.62 m);

(*2*) Enclosures are free from probable contact with ground, grounded metal, metal laths, or other conductive materials; and

(*3*) Enclosures are guarded against employee contact.

(ii) *Service equipment enclosures.* Metal enclosures for service equipment shall be grounded.

(iii) *Fixed equipment.* Exposed noncurrent-carrying metal parts of fixed equipment which may become energized shall be grounded under any of the following conditions:

(A) If within 8 feet (2.44 m) vertically or 5 feet (1.52 m) horizontally of ground or grounded metal objects and subject to employee contact.

(B) If located in a wet or damp location and subject to employee contact.

(C) If in electrical contact with metal.

(D) If in a hazardous (classified) location.

(E) If supplied by a metal-clad, metal-sheathed, or grounded metal raceway wiring method.

(F) If equipment operates with any terminal at over 150 volts to ground; however, the following need not be grounded:

(*1*) Enclosures for switches or circuit breakers used for other than service equipment and accessible to qualified persons only;

(*2*) Metal frames of electrically heated appliances which are permanently and effectively insulated from ground; and

(*3*) The cases of distribution apparatus such as transformers and capacitors mounted on wooden poles at a height exceeding 8 feet (2.44 m) above ground or grade level.

(iv) *Equipment connected by cord and plug.* Under any of the conditions described in paragraphs (f)(7)(iv)(A) through (f)(7)(iv)(C) of this section, exposed noncurrent-carrying metal parts of cord- and plug-connected equipment which may become energized shall be grounded:

(A) If in a hazardous (classified) location (see § 1926.407).

(B) If operated at over 150 volts to ground, except for guarded motors and metal frames of electrically heated appliances if the appliance frames are permanently and effectively insulated from ground.

(C) If the equipment is one of the

types listed in paragraphs (f)(7)(iv)(C)(*1*) through (f)(7)(iv)(C)(*5*) of this section. However, even though the equipment may be one of these types, it need not be grounded if it is exempted by paragraph (f)(7)(iv)(C)(*6*).

(*1*) Hand held motor-operated tools;

(*2*) Cord- and plug-connected equipment used in damp or wet locations or by employees standing on the ground or on metal floors or working inside of metal tanks or boilers;

(*3*) Portable and mobile X-ray and associated equipment;

(*4*) Tools likely to be used in wet and/or conductive locations; and

(*5*) Portable hand lamps.

(*6*) Tools likely to be used in wet and/or conductive locations need not be grounded if supplied through an isolating transformer with an ungrounded secondary of not over 50 volts. Listed or labeled portable tools and appliances protected by a system of double insulation, or its equivalent, need not be grounded. If such a system is employed, the equipment shall be distinctively marked to indicate that the tool or appliance utilizes a system of double insulation.

(v) *Nonelectrical equipment.* The metal parts of the following nonelectrical equipment shall be grounded: frames and tracks of electrically operated cranes; frames of nonelectricallv driven elevator cars to which electric conductors are attached; hand-operated metal shifting ropes or cables of electric elevators, and metal partitions, grill work, and similar metal enclosures around equipment of over 1kV between conductors.

(8) *Methods of grounding equipment*—(i) *With circuit conductors.* Noncurrent-carrying metal parts of fixed equipment, if required to be grounded by this subpart, shall be grounded by an equipment grounding conductor which is contained within the same raceway, cable, or cord, or runs with or encloses the circuit conductors. For DC circuits only, the equipment grounding conductor may be run separately from the circuit conductors.

(ii) *Grounding conductor.* A conductor used for grounding fixed or movable equipment shall have capacity to conduct safely any fault current which may be imposed on it.

(iii) *Equipment considered effectively grounded.* Electric equipment is considered to be effectively grounded if it is secured to, and in electrical contact with, a metal rack or structure that is provided for its support and the metal rack or structure is grounded by the method specified for the noncurrent-carrying metal parts of fixed equipment in paragraph (f)(8)(i) of this section. Metal car frames supported by metal hoisting cables attached to or running over metal sheaves or drums of grounded elevator machines are also considered to be effectively grounded.

(9) *Bonding.* If bonding conductors are used to assure electrical continuity, they shall have the capacity to conduct any fault current which may be imposed.

(10) *Made electrodes.* If made electrodes are used, they shall be free from nonconductive coatings, such as paint or enamel; and, if practicable, they shall be embedded below permanent moisture level. A single electrode consisting of a rod, pipe or plate which has a resistance to ground greater than 25 ohms shall be augmented by one additional electrode installed no closer than 6 feet (1.83 m) to the first electrode.

(11) *Grounding of systems and circuits of 1000 volts and over (high voltage)*—(i) *General.* If high voltage systems are grounded, they shall comply with all applicable provisions of paragraphs (f)(1) through (f)(10) of this section as supplemented and modified by this paragraph (f)(11).

(ii) *Grounding of systems supplying portable or mobile equipment.* Systems supplying portable or mobile high voltage equipment, other than substations installed on a temporary basis, shall comply with the following:

(A) Portable and mobile high voltage equipment shall be supplied from a system having its neutral grounded through an impedance. If a delta-connected high voltage system is used to supply the equipment, a system neutral shall be derived.

(B) Exposed noncurrent-carrying metal parts of portable and mobile equipment shall be connected by an equipment grounding conductor to the point at which the system neutral impedance is grounded.

(C) Ground-fault detection and relaying shall be provided to automatically de-energize any high voltage system component which has developed a ground fault. The continuity of the equipment grounding conductor shall be continuously monitored so as to de-energize automatically the high voltage feeder to the portable equipment upon loss of continuity of the equipment grounding conductor.

(D) The grounding electrode to which the portable or mobile equipment system neutral impedance is connected shall be isolated from and separated in the ground by at least 20 feet (6.1 m) from any other system or equipment grounding electrode, and there shall be no direct connection between the grounding electrodes, such as buried pipe, fence or like objects.

(iii) *Grounding of equipment.* All noncurrent-carrying metal parts of portable equipment and fixed equipment including those associated fences, housings, enclosures, and supporting structures shall be grounded. However, equipment which is guarded by location and isolated from ground need not be grounded. Additionally, pole-mounted distribution apparatus at a height exceeding 8 feet (2.44 m) above ground or grade level need not be grounded.

(Information collection requirements contained in paragraphs (b)(1)(iii)(A) and (b)(1)(iii)(G) were approved by the Office of Management and Budget under control number: 1218-0062; information collection requirements contained in paragraph (f)(7)(iv)(C)(6) were approved by the Office of Management and Budget under control number: 1218-0130)

§ 1926.405 Wiring methods, components, and equipment for general use.

(a) *Wiring methods.* The provisions of this paragraph do not apply to conductors which form an integral part of equipment such as motors, controllers, motor control centers and like equipment.

(1) *General requirements.*—(i) *Electrical continuity of metal raceways and enclosures.* Metal raceways, cable armor, and other metal enclosures for conductors shall be metallically joined together into a continuous electric conductor and shall be so connected to all boxes, fittings, and cabinets as to provide effective electrical continuity.

(ii) *Wiring in ducts.* No wiring systems of any type shall be installed in ducts used to transport dust, loose stock or flammable vapors. No wiring system of any type shall be installed in any duct used for vapor removal or in any shaft containing only such ducts.

(2) *Temporary wiring*—(i) *Scope.* The provisions of paragraph (a)(2) of this section apply to temporary electrical power and lighting wiring methods which may be of a class less than would be required for a permanent installation. Except as specifically modified in paragraph (a)(2) of this section, all other requirements of this subpart for permanent wiring shall apply to temporary wiring installations. Temporary wiring shall be removed immediately upon completion of construction or the purpose for which the wiring was installed.

(ii) *General requirements for temporary wiring.* (A) Feeder shall originate in a distribution center. The conductors shall be run as multiconductor cord or cable assemblies or within raceways; or, where not subject to physical damage, they may be run as open conductors on insulators not more than 10 feet (3.05 m) apart.

(B) Branch circuits shall originate in a power outlet or panelboard. Conductors shall be run as multiconductor cord or cable assemblies or open conductors, or shall be run in raceways. All conductors shall be protected by overcurrent devices at their ampacity. Runs of open conductors shall be located where the conductors will not be subject to physical damage, and the conductors shall be fastened at intervals not exceeding 10 feet (3.05 m). No branch-circuit conductors shall be laid on the floor. Each branch circuit that supplies receptacles or fixed equipment shall contain a separate equipment grounding conductor if the branch circuit is run as open conductors.

(C) Receptacles shall be of the grounding type. Unless installed in a complete metallic raceway, each branch circuit shall contain a separate equipment grounding conductor, and all receptacles shall be electrically connected to the grounding conductor. Receptacles for uses other than temporary lighting

shall not be installed on branch circuits which supply temporary lighting. Receptacles shall not be connected to the same ungrounded conductor of multiwire circuits which supply temporary lighting.

(D) Disconnecting switches or plug connectors shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit.

(E) All lamps for general illumination shall be protected from accidental contact or breakage. Metal-case sockets shall be grounded.

(F) Temporary lights shall not be suspended by their electric cords unless cords and lights are designed for this means of suspension.

(G) Portable electric lighting used in wet and/or other conductive locations, as for example, drums, tanks, and vessels, shall be operated at 12 volts or less. However, 120-volt lights may be used if protected by a ground-fault circuit interrupter.

(H) A box shall be used wherever a change is made to a raceway system or a cable system which is metal clad or metal sheathed.

(I) Flexible cords and cables shall be protected from damage. Sharp corners and projections shall be avoided. Flexible cords and cables may pass through doorways or other pinch points, if protection is provided to avoid damage.

(J) Extension cord sets used with portable electric tools and appliances shall be of three-wire type and shall be designed for hard or extra-hard usage. Flexible cords used with temporary and portable lights shall be designed for hard or extra-hard usage.

NOTE: The National Electrical Code, ANSI/NFPA 70, in Article 400, Table 400-4, lists various types of flexible cords, some of which are noted as being designed for hard or extra-hard usage. Examples of these types of flexible cords include hard service cord (types S, ST, SO, STO) and junior hard service cord (types SJ, SJO, SJT, SJTO).

(iii) *Guarding.* For temporary wiring over 600 volts, nominal, fencing, barriers, or other effective means shall be provided to prevent access of other than authorized and qualified personnel.

(b) *Cabinets, boxes, and fittings*—(1) *Conductors entering boxes, cabinets, or fittings.* Conductors entering boxes, cabinets, or fittings shall be protected from abrasion, and openings through which conductors enter shall be effectively closed. Unused openings in cabinets, boxes, and fittings shall also be effectively closed.

(2) *Covers and canopies.* All pull boxes, junction boxes, and fittings shall be provided with covers. If metal covers are used, they shall be grounded. In energized installations each outlet box shall have a cover, faceplate, or fixture canopy. Covers of outlet boxes having holes through which flexible cord pendants pass shall be provided with bushings designed for the purpose or shall have smooth, well-rounded surfaces on which the cords may bear.

(3) *Pull and junction boxes for systems over 600 volts, nominal.* In addition to other requirements in this section for pull and junction boxes, the following shall apply to these boxes for systems over 600 volts, nominal:

(i) *Complete enclosure.* Boxes shall provide a complete enclosure for the contained conductors or cables.

(ii) *Covers.* Boxes shall be closed by covers securely fastened in place. Underground box covers that weigh over 100 pounds (43.6 kg) meet this requirement. Covers for boxes shall be permanently marked "HIGH VOLTAGE." The marking shall be on the outside of the box cover and shall be readily visible and legible.

(c) *Knife switches.* Single-throw knife switches shall be so connected that the blades are dead when the switch is in the open position. Single-throw knife switches shall be so placed that gravity will not tend to close them. Single-throw knife switches approved for use in the inverted position shall be provided with a locking device that will ensure that the blades remain in the open position when so set. Double-throw knife switches may be mounted so that the throw will be either vertical or horizontal. However, if the throw is vertical, a locking device shall be provided to ensure that the blades remain in the open position when so set.

(d) *Switchboards and panelboards.* Switchboards that have any exposed live parts shall be located in permanently dry locations and accessible only to qualified persons. Panelboards shall

be mounted in cabinets, cutout boxes, or enclosures designed for the purpose and shall be dead front. However, panelboards other than the dead front externally-operable type are permitted where accessible only to qualified persons. Exposed blades of knife switches shall be dead when open.

(e) *Enclosures for damp or wet locations*—(1) *Cabinets, fittings, and boxes.* Cabinets, cutout boxes, fittings, boxes, and panelboard enclosures in damp or wet locations shall be installed so as to prevent moisture or water from entering and accumulating within the enclosures. In wet locations the enclosures shall be weatherproof.

(2) *Switches and circuit breakers.* Switches, circuit breakers, and switchboards installed in wet locations shall be enclosed in weatherproof enclosures.

(f) *Conductors for general wiring.* All conductors used for general wiring shall be insulated unless otherwise permitted in this Subpart. The conductor insulation shall be of a type that is suitable for the voltage, operating temperature, and location of use. Insulated conductors shall be distinguishable by appropriate color or other means as being grounded conductors, ungrounded conductors, or equipment grounding conductors.

(g) *Flexible cords and cables*—(1) *Use of flexible cords and cables*—(i) *Permitted uses.* Flexible cords and cables shall be suitable for conditions of use and location. Flexible cords and cables shall be used only for:

(A) Pendants;

(B) Wiring of fixtures;

(C) Connection of portable lamps or appliances;

(D) Elevator cables;

(E) Wiring of cranes and hoists;

(F) Connection of stationary equipment to facilitate their frequent interchange;

(G) Prevention of the transmission of noise or vibration; or

(H) Appliances where the fastening means and mechanical connections are designed to permit removal for maintenance and repair.

(ii) *Attachment plugs for cords.* If used as permitted in paragraphs (g)(1)(i)(C), (G)(1)(i)(F), or (g)(1)(i)(H) of this section, the flexible cord shall be equipped with an attachment plug and shall be energized from a receptacle outlet.

(iii) *Prohibited uses.* Unless necessary for a use permitted in paragraph (g)(1)(i) of this section, flexible cords and cables shall not be used:

(A) As a substitute for the fixed wiring of a structure;

(B) Where run through holes in walls, ceilings, or floors;

(C) Where run through doorways, windows, or similar openings, except as permitted in paragraph (a)(2)(ii)(I) of this section;

(D) Where attached to building surfaces; or

(E) Where concealed behind building walls, ceilings, or floors.

(2) *Identification, splices, and terminations*—(i) *Identification.* A conductor of a flexible cord or cable that is used as a grounded conductor or an equipment grounding conductor shall be distinguishable from other conductors.

(ii) *Marking.* Type SJ, SJO, SJT, SJTO, S, SO, ST, and STO cords shall not be used unless durably marked on the surface with the type designation, size, and number of conductors.

(iii) *Splices.* Flexible cords shall be used only in continuous lengths without splice or tap. Hard service flexible cords No. 12 or larger may be repaired if spliced so that the splice retains the insulation, outer sheath properties, and usage characteristics of the cord being spliced.

(iv) *Strain relief.* Flexible cords shall be connected to devices and fittings so that strain relief is provided which will prevent pull from being directly transmitted to joints or terminal screws.

(v) *Cords passing through holes.* Flexible cords and cables shall be protected by bushings or fittings where passing through holes in covers, outlet boxes, or similar enclosures.

(h) *Portable cables over 600 volts, nominal.* Multiconductor portable cable for use in supplying power to portable or mobile equipment at over 600 volts, nominal, shall consist of No. 8 or larger conductors employing flexible stranding. Cables operated at over 2000 volts shall be shielded for the purpose of confining the voltage stresses to the insulation. Grounding conductors shall be provided.

Connectors for these cables shall be of a locking type with provisions to prevent their opening or closing while energized. Strain relief shall be provided at connections and terminations. Portable cables shall not be operated with splices unless the splices are of the permanent molded, vulcanized, or other equivalent type. Termination enclosures shall be marked with a high voltage hazard warning, and terminations shall be accessible only to authorized and qualified personnel.

(i) *Fixture wires*—(1) *General.* Fixture wires shall be suitable for the voltage, temperature, and location of use. A fixture wire which is used as a grounded conductor shall be identified.

(2) *Uses permitted.* Fixture wires may be used:

(i) For installation in lighting fixtures and in similar equipment where enclosed or protected and not subject to bending or twisting in use; or

(ii) For connecting lighting fixtures to the branch-circuit conductors supplying the fixtures.

(3) *Uses not permitted.* Fixture wires shall not be used as branch-circuit conductors except as permitted for Class 1 power-limited circuits.

(j) *Equipment for general use*—(1) *Lighting fixtures, lampholders, lamps, and receptacles*—(i) *Live parts.* Fixtures, lampholders, lamps, rosettes, and receptacles shall have no live parts normally exposed to employee contact. However, rosettes and cleat-type lampholders and receptacles located at least 8 feet (2.44 m) above the floor may have exposed parts.

(ii) *Support.* Fixtures, lampholders, rosettes, and receptacles shall be securely supported. A fixture that weighs more than 6 pounds (2.72 kg) or exceeds 16 inches (406 mm) in any dimension shall not be supported by the screw shell of a lampholder.

(iii) *Portable lamps.* Portable lamps shall be wired with flexible cord and an attachment plug of the polarized or grounding type. If the portable lamp uses an Edison-based lampholder, the grounded conductor shall be identified and attached to the screw shell and the identified blade of the attachment plug. In addition, portable handlamps shall comply with the following:

(A) Metal shell, paperlined lampholders shall not be used;

(B) Handlamps shall be equipped with a handle of molded composition or other insulating material;

(C) Handlamps shall be equipped with a substantial guard attached to the lampholder or handle;

(D) Metallic guards shall be grounded by the means of an equipment grounding conductor run within the power supply cord.

(iv) *Lampholders.* Lampholders of the screw-shell type shall be installed for use as lampholders only. Lampholders installed in wet or damp locations shall be of the weatherproof type.

(v) *Fixtures.* Fixtures installed in wet or damp locations shall be identified for the purpose and shall be installed so that water cannot enter or accumulate in wireways, lampholders, or other electrical parts.

(2) *Receptacles, cord connectors, and attachment plugs (caps)*—(i) *Configuration.* Receptacles, cord connectors, and attachment plugs shall be constructed so that no receptacle or cord connector will accept an attachment plug with a different voltage or current rating than that for which the device is intended. However, a 20-ampere T-slot receptacle or cord connector may accept a 15-ampere attachment plug of the same voltage rating. Receptacles connected to circuits having different voltages, frequencies, or types of current (ac or dc) on the same premises shall be of such design that the attachment plugs used on these circuits are not interchangeable.

(ii) *Damp and wet locations.* A receptacle installed in a wet or damp location shall be designed for the location.

(3) *Appliances*—(i) *Live parts.* Appliances, other than those in which the current-carrying parts at high temperatures are necessarily exposed, shall have no live parts normally exposed to employee contact.

(ii) *Disconnecting means.* A means shall be provided to disconnect each appliance.

(iii) *Rating.* Each appliance shall be marked with its rating in volts and amperes or volts and watts.

(4) *Motors.* This paragraph applies to

motors, motor circuits, and controllers.

(i) *In sight from.* If specified that one piece of equipment shall be "in sight from" another piece of equipment, one shall be visible and not more than 50 feet (15.2 m) from the other.

(ii) *Disconnecting means*—(A) A disconnecting means shall be located in sight from the controller location. The controller disconnecting means for motor branch circuits over 600 volts, nominal, may be out of sight of the controller, if the controller is marked with a warning label giving the location and identification of the disconnecting means which is to be locked in the open position.

(B) The disconnecting means shall disconnect the motor and the controller from all ungrounded supply conductors and shall be so designed that no pole can be operated independently.

(C) If a motor and the driven machinery are not in sight from the controller location, the installation shall comply with one of the following conditions:

(*1*) The controller disconnecting means shall be capable of being locked in the open position.

(*2*) A manually operable switch that will disconnect the motor from its source of supply shall be placed in sight from the motor location.

(D) The disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position.

(E) The disconnecting means shall be readily accessible. If more than one disconnect is provided for the same equipment, only one need be readily accessible.

(F) An individual disconnecting means may be used for a group of motors under any one of the following conditions:

(*1*) If a number of motors drive special parts of a single machine or piece of apparatus, such as a metal or woodworking machine, crane, or hoist;

(*2*) If a group of motors is under the protection of one set of branch-circuit protective devices; or

(*3*) If a group of motors is in a single room in sight from the location of the disconnecting means.

(iii) *Motor overload, short-circuit, and ground-fault protection.* Motors, motor-control apparatus, and motor branch-circuit conductors shall be protected against overheating due to motor overloads or failure to start, and against short-circuits or ground faults. These provisions do not require overload protection that will stop a motor where a shutdown is likely to introduce additional or increased hazards, as in the case of fire pumps, or where continued operation of a motor is necessary for a safe shutdown of equipment or process and motor overload sensing devices are connected to a supervised alarm.

(iv) *Protection of live parts—all voltages.* (A) Stationary motors having commutators, collectors, and brush rigging located inside of motor end brackets and not conductively connected to supply circuits operating at more than 150 volts to ground need not have such parts guarded. Exposed live parts of motors and controllers operating at 50 volts or more between terminals shall be guarded against accidental contact by any of the following:

(*1*) By installation in a room or enclosure that is accessible only to qualified persons;

(*2*) By installation on a balcony, gallery, or platform, so elevated and arranged as to exclude unqualified persons; or

(*3*) By elevation 8 feet (2.44 m) or more above the floor.

(B) Where live parts of motors or controllers operating at over 150 volts to ground are guarded against accidental contact only by location, and where adjustment or other attendance may be necessary during the operation of the apparatus, insulating mats or platforms shall be provided so that the attendant cannot readily touch live parts unless standing on the mats or platforms.

(5) *Transformers*—(i) *Application.* The following paragraphs cover the installation of all transformers, except:

(A) Current transformers;

(B) Dry-type transformers installed as a component part of other apparatus;

(C) Transformers used with Class 2 and Class 3 circuits, sign and outline lighting, electric discharge lighting, and power-limited fire-protective signaling circuits.

(ii) *Operating voltage.* The operating voltage of exposed live parts of transformer installations shall be indicated

by warning signs or visible markings on the equipment or structure.

(iii) *Transformers over 35 kV.* Dry-type, high fire point liquid-insulated, and askarel-insulated transformers installed indoors and rated over 35 kV shall be in a vault.

(iv) *Oil-insulated transformers.* If they present a fire hazard to employees, oil-insulated transformers installed indoors shall be in a vault.

(v) *Fire protection.* Combustible material, combustible buildings and parts of buildings, fire escapes, and door and window openings shall be safeguarded from fires which may originate in oil-insulated transformers attached to or adjacent to a building or combustible material.

(vi) *Transformer vaults.* Transformer vaults shall be constructed so as to contain fire and combustible liquids within the vault and to prevent unauthorized access. Locks and latches shall be so arranged that a vault door can be readily opened from the inside.

(vii) *Pipes and ducts.* Any pipe or duct system foreign to the vault installation shall not enter or pass through a transformer vault.

(viii) *Material storage.* Materials shall not be stored in transformer vaults.

(6) *Capacitors*—(i) *Drainage of stored charge.* All capacitors, except surge capacitors or capacitors included as a component part of other apparatus, shall be provided with an automatic means of draining the stored charge and maintaining the discharged state after the capacitor is disconnected from its source of supply.

(ii) *Over 600 volts.* Capacitors rated over 600 volts, nominal, shall comply with the following additional requirements:

(A) Isolating or disconnecting switches (with no interrupting rating) shall be interlocked with the load interrupting device or shall be provided with prominently displayed caution signs to prevent switching load current.

(B) For series capacitors the proper switching shall be assured by use of at least one of the following:

(*1*) Mechanically sequenced isolating and bypass switches,

(*2*) Interlocks, or

(*3*) Switching procedure prominently displayed at the switching location.

(Information collection requirements contained in paragraphs (g)(2)(ii), (j)(3)(iii), (j)(4)(ii)(A), (j)(5)(ii), and (j)(6)(ii)(B)(3) were approved by the Office of Management and Budget under control number: 1218-0130)

§ 1926.406 Specific purpose equipment and installations.

(a) *Cranes and hoists.* This paragraph applies to the installation of electric equipment and wiring used in connection with cranes, monorail hoists, hoists, and all runways.

(1) *Disconnecting means*—(i) *Runway conductor disconnecting means.* A readily accessible disconnecting means shall be provided between the runway contact conductors and the power supply.

(ii) *Disconnecting means for cranes and monorail hoists.* A disconnecting means, capable of being locked in the open position, shall be provided in the leads from the runway contact conductors or other power supply or any crane or monorail hoist.

(A) If this additional disconnecting means is not readily accessible from the crane or monorail hoist operating station, means shall be provided at the operating station to open the power circuit to all motors of the crane or monorail hoist.

(B) The additional disconnect may be omitted if a monorail hoist or hand-propelled crane bridge installation meets all of the following:

(*1*) The unit is floor controlled;

(*2*) The unit is within view of the power supply disconnecting means; and

(*3*) No fixed work platform has been provided for servicing the unit.

(2) *Control.* A limit switch or other device shall be provided to prevent the load block from passing the safe upper limit of travel of any hoisting mechanism.

(3) *Clearance.* The dimension of the working space in the direction of access to live parts which may require examination, adjustment, servicing, or maintenance while alive shall be a minimum of 2 feet 6 inches (762 mm). Where controls are enclosed in cabinets, the door(s) shall open at least 90 degrees or be removable, or the installation shall provide equivalent access.

(4) *Grounding.* All exposed metal parts of cranes, monorail hoists, hoists

and accessories including pendant controls shall be metallically joined together into a continuous electrical conductor so that the entire crane or hoist will be grounded in accordance with § 1926.404(f). Moving parts, other than removable accessories or attachments, having metal-to-metal bearing surfaces shall be considered to be electrically connected to each other through the bearing surfaces for grounding purposes. The trolley frame and bridge frame shall be considered as electrically grounded through the bridge and trolley wheels and its respective tracks unless conditions such as paint or other insulating materials prevent reliable metal-to-metal contact. In this case a separate bonding conductor shall be provided.

(b) *Elevators, escalators, and moving walks*—(1) *Disconnecting means.* Elevators, escalators, and moving walks shall have a single means for disconnecting all ungrounded main power supply conductors for each unit.

(2) *Control panels.* If control panels are not located in the same space as the drive machine, they shall be located in cabinets with doors or panels capable of being locked closed.

(c) *Electric welders—disconnecting means*—(1) *Motor-generator, AC transformer, and DC rectifier arc welders.* A disconnecting means shall be provided in the supply circuit for each motor-generator arc welder, and for each AC transformer and DC rectifier arc welder which is not equipped with a disconnect mounted as an integral part of the welder.

(2) *Resistance welders.* A switch or circuit breaker shall be provided by which each resistance welder and its control equipment can be isolated from the supply circuit. The ampere rating of this disconnecting means shall not be less than the supply conductor ampacity.

(d) *X-ray equipment*—(1) *Disconnecting means*—(i) *General.* A disconnecting means shall be provided in the supply circuit. The disconnecting means shall be operable from a location readily accessible from the X-ray control. For equipment connected to a 120-volt branch circuit of 30 amperes or less, a grounding-type attachment plug cap and receptacle of proper rating may serve as a disconnecting means.

(ii) *More than one piece of equipment.* If more than one piece of equipment is operated from the same high-voltage circuit, each piece or each group of equipment as a unit shall be provided with a high-voltage switch or equivalent disconnecting means. This disconnecting means shall be constructed, enclosed, or located so as to avoid contact by employees with its live parts.

(2) *Control. Radiographic and fluoroscopic types.* Radiographic- and fluoroscopic-type equipment shall be effectively enclosed or shall have interlocks that deenergize the equipment automatically to prevent ready access to live current-carrying parts.

§ 1926.407 Hazardous (classified) locations.

(a) *Scope.* This section sets forth requirements for electric equipment and wiring in locations which are classified depending on the properties of the flammable vapors, liquids or gases, or combustible dusts or fibers which may be present therein and the likelihood that a flammable or combustible concentration or quantity is present. Each room, section or area shall be considered individually in determining its classification. These hazardous (classified) locations are assigned six designations as follows:

Class I, Division 1
Class I, Division 2
Class II, Division 1
Class II, Division 2
Class III, Division 1
Class III, Division 2

For definitions of these locations see § 1926.449. All applicable requirements in this subpart apply to all hazardous (classified) locations, unless modified by provisions of this section.

(b) *Electrical installations.* Equipment, wiring methods, and installations of equipment in hazardous (classified) locations shall be approved as intrinsically safe or approved for the hazardous (classified) location or safe for the hazardous (classified) location. Requirements for each of these options are as follows:

(1) *Intrinsically safe.* Equipment and associated wiring approved as intrinsically safe is permitted in any hazardous (classified) location included in its listing or labeling.

(2) *Approved for the hazardous (classified) location*—(i) *General.* Equipment shall be approved not only for the class of location but also for the ignitible or combustible properties of the specific gas, vapor, dust, or fiber that will be present.

NOTE: NFPA 70, the National Electrical Code, lists or defines hazardous gases, vapors, and dusts by "Groups" characterized by their ignitible or combustible properties.

(ii) *Marking.* Equipment shall not be used unless it is marked to show the class, group, and operating temperature or temperature range, based on operation in a 40-degree C ambient, for which it is approved. The temperature marking shall not exceed the ignition temperature of the specific gas, vapor, or dust to be encountered. However, the following provisions modify this marking requirement for specific equipment:

(A) Equipment of the non-heat-producing type (such as junction boxes, conduit, and fittings) and equipment of the heat-producing type having a maximum temperature of not more than 100 degrees C (212 degrees F) need not have a marked operating temperature or temperature range.

(B) Fixed lighting fixtures marked for use only in Class I, Division 2 locations need not be marked to indicate the group.

(C) Fixed general-purpose equipment in Class I locations, other than lighting fixtures, which is acceptable for use in Class I, Division 2 locations need not be marked with the class, group, division, or operating temperature.

(D) Fixed dust-tight equipment, other than lighting fixtures, which is acceptable for use in Class II, Division 2 and Class III locations need not be marked with the class, group, division, or operating temperature.

(3) *Safe for the hazardous (classified) location.* Equipment which is safe for the location shall be of a type and design which the employer demonstrates will provide protection from the hazards arising from the combustibility and flammability of vapors, liquids, gases, dusts, or fibers.

NOTE: The National Electrical Code, NFPA 70, contains guidelines for determining the type and design of equipment and installations which will meet this requirement. The guidelines of this document address electric wiring, equipment, and systems installed in hazardous (classified) locations and contain specific provisions for the following: wiring methods, wiring connections, conductor insulation, flexible cords, sealing and drainage, transformers, capacitors, switches, circuit breakers, fuses, motor controllers, receptacles, attachment plugs, meters, relays, instruments, resistors, generators, motors, lighting fixtures, storage battery charging equipment, electric cranes, electric hoists and similar equipment, utilization equipment, signaling systems, alarm systems, remote control systems, local loud speaker and communication systems, ventilation piping, live parts, lightning surge protection, and grounding. Compliance with these guidelines will constitute one means, but not the only means, of compliance with this paragraph.

(c) *Conduits.* All conduits shall be threaded and shall be made wrenchtight. Where it is impractical to make a threaded joint tight, a bonding jumper shall be utilized.

(Information collection requirements contained in paragraph (b)(2)(ii) were approved by the Office of Management and Budget under control number: 1218–0130)

§ 1926.408 Special systems.

(a) *Systems over 600 volts, nominal.* Paragraphs (a)(1) through (a)(4) of this section contain general requirements for all circuits and equipment operated at over 600 volts.

(1) *Wiring methods for fixed installations*—(i) *Above-ground.* Above-ground conductors shall be installed in rigid metal conduit, in intermediate metal conduit, in cable trays, in cablebus, in other suitable raceways, or as open runs of metal-clad cable designed for the use and purpose. However, open runs of non-metallic-sheathed cable or of bare conductors or busbars may be installed in locations which are accessible only to qualified persons. Metallic shielding components, such as tapes, wires, or braids for conductors, shall be grounded. Open runs of insulated wires and cables having a bare lead sheath or a braided outer covering shall be supported in a manner designed to prevent physical damage to the braid or sheath.

(ii) *Installations emerging from the ground.* Conductors emerging from the ground shall be enclosed in raceways.

Raceways installed on poles shall be of rigid metal conduit, intermediate metal conduit, PVC schedule 80 or equivalent extending from the ground line up to a point 8 feet (2.44 m) above finished grade. Conductors entering a building shall be protected by an enclosure from the ground line to the point of entrance. Metallic enclosures shall be grounded.

(2) *Interrupting and isolating devices*—(i) *Circuit breakers.* Circuit breakers located indoors shall consist of metal-enclosed or fire-resistant, cell-mounted units. In locations accessible only to qualified personnel, open mounting of circuit breakers is permitted. A means of indicating the open and closed position of circuit breakers shall be provided.

(ii) *Fused cutouts.* Fused cutouts installed in buildings or transformer vaults shall be of a type identified for the purpose. They shall be readily accessible for fuse replacement.

(iii) *Equipment isolating means.* A means shall be provided to completely isolate equipment for inspection and repairs. Isolating means which are not designed to interrupt the load current of the circuit shall be either interlocked with a circuit interrupter or provided with a sign warning against opening them under load.

(3) *Mobile and portable equipment*—(i) *Power cable connections to mobile machines.* A metallic enclosure shall be provided on the mobile machine for enclosing the terminals of the power cable. The enclosure shall include provisions for a solid connection for the ground wire(s) terminal to ground effectively the machine frame. The method of cable termination used shall prevent any strain or pull on the cable from stressing the electrical connections. The enclosure shall have provision for locking so only authorized qualified persons may open it and shall be marked with a sign warning of the presence of energized parts.

(ii) *Guarding live parts.* All energized switching and control parts shall be enclosed in effectively grounded metal cabinets or enclosures. Circuit breakers and protective equipment shall have the operating means projecting through the metal cabinet or enclosures so these units can be reset without locked doors being opened. Enclosures and metal cabinets shall be locked so that only authorized qualified persons have access and shall be marked with a sign warning of the presence of energized parts. Collector ring assemblies on revolving-type machines (shovels, draglines, etc.) shall be guarded.

(4) *Tunnel installations*—(i) *Application.* The provisions of this paragraph apply to installation and use of high-voltage power distribution and utilization equipment which is associated with tunnels and which is portable and/or mobile, such as substations, trailers, cars, mobile shovels, draglines, hoists, drills, dredges, compressors, pumps, conveyors, and underground excavators.

(ii) *Conductors.* Conductors in tunnels shall be installed in one or more of the following:

(A) Metal conduit or other metal raceway,

(B) Type MC cable, or

(C) Other suitable multiconductor cable.

Conductors shall also be so located or guarded as to protect them from physical damage. Multiconductor portable cable may supply mobile equipment. An equipment grounding conductor shall be run with circuit conductors inside the metal raceway or inside the multiconductor cable jacket. The equipment grounding conductor may be insulated or bare.

(iii) *Guarding live parts.* Bare terminals of transformers, switches, motor controllers, and other equipment shall be enclosed to prevent accidental contact with energized parts. Enclosures for use in tunnels shall be drip-proof, weatherproof, or submersible as required by the environmental conditions.

(iv) *Disconnecting means.* A disconnecting means that simultaneously opens all ungrounded conductors shall be installed at each transformer or motor location.

(v) *Grounding and bonding.* All nonenergized metal parts of electric equipment and metal raceways and cable sheaths shall be grounded and bonded to all metal pipes and rails at the portal and at intervals not exceeding 1000 feet (305 m) throughout the tunnel.

(b) *Class 1, Class 2, and Class 3 remote control, signaling, and power-limited circuits*—(1) *Classification.* Class 1, Class 2, or Class 3 remote control, signaling, or power-limited circuits are characterized by their usage and electrical power limitation which differentiates them from light and power circuits. These circuits are classified in accordance with their respective voltage and power limitations as summarized in paragraphs (b)(1)(i) through (b)(1)(iii) of this section.

(i) *Class 1 circuits.*—(A) A class 1 power-limited circuit is supplied from a source having a rated output of not more than 30 volts and 1000 volt-amperes.

(B) A Class 1 remote control circuit or a Class 1 signaling circuit has a voltage which does not exceed 600 volts; however, the power output of the source need not be limited.

(ii) *Class 2 and Class 3 circuits.*—(A) Power for Class 2 and Class 3 circuits is limited either inherently (in which no overcurrent protection is required) or by a combination of a power source and overcurrent protection.

(B) The maximum circuit voltage is 150 volts AC or DC for a Class 2 inherently limited power source, and 100 volts AC or DC for a Class 3 inherently limited power source.

(C) The maximum circuit voltage is 30 volts AC and 60 volts DC for a Class 2 power source limited by overcurrent protection, and 150 volts AC or DC for a Class 3 power source limited by overcurrent protection.

(iii) *Application.* The maximum circuit voltages in paragraphs (b)(1)(i) and (b)(1)(ii) of this section apply to sinusoidal AC or continuous DC power sources, and where wet contact occurrence is not likely.

(2) *Marking.* A Class 2 or Class 3 power supply unit shall not be used unless it is durably marked where plainly visible to indicate the class of supply and its electrical rating.

(c) *Communications systems*—(1) *Scope.* These provisions for communication systems apply to such systems as central-station-connected and non-central-station-connected telephone circuits, radio receiving and transmitting equipment, and outside wiring for fire and burglar alarm, and similar central station systems. These installations need not comply with the provisions of §§ 1926.403 through 1926.408(b), except § 1926.404(c)(1)(ii) and § 1926.407.

(2) *Protective devices*—(i) *Circuits exposed to power conductors.* Communication circuits so located as to be exposed to accidental contact with light or power conductors operating at over 300 volts shall have each circuit so exposed provided with an approved protector.

(ii) *Antenna lead-ins.* Each conductor of a lead-in from an outdoor antenna shall be provided with an antenna discharge unit or other means that will drain static charges from the antenna system.

(3) *Conductor location*—(i) *Outside of buildings.*—(A) Receiving distribution lead-in or aerial-drop cables attached to buildings and lead-in conductors to radio transmitters shall be so installed as to avoid the possibility of accidental contact with electric light or power conductors.

(B) The clearance between lead-in conductors and any lightning protection conductors shall not be less than 6 feet (1.83 m).

(ii) *On poles.* Where practicable, communication conductors on poles shall be located below the light or power conductors. Communications conductors shall not be attached to a crossarm that carries light or power conductors.

(iii) *Inside of buildings.* Indoor antennas, lead-ins, and other communication conductors attached as open conductors to the inside of buildings shall be located at least 2 inches (50.8 mm) from conductors of any light or power or Class 1 circuits unless a special and equally protective method of conductor separation is employed.

(4) *Equipment location.* Outdoor metal structures supporting antennas, as well as self-supporting antennas such as vertical rods or dipole structures, shall be located as far away from overhead conductors of electric light and power circuits of over 150 volts to ground as necessary to avoid the possibility of the antenna or structure falling into or making accidental contact with such circuits.

(5) *Grounding*—(i) *Lead-in conductors.*

If exposed to contact with electric light or power conductors, the metal sheath of aerial cables entering buildings shall be grounded or shall be interrupted close to the entrance to the building by an insulating joint or equivalent device. Where protective devices are used, they shall be grounded.

(ii) *Antenna structures.* Masts and metal structures supporting antennas shall be permanently and effectively grounded without splice or connection in the grounding conductor.

(iii) *Equipment enclosures.* Transmitters shall be enclosed in a metal frame or grill or separated from the operating space by a barrier, all metallic parts of which are effectively connected to ground. All external metal handles and controls accessible to the operating personnel shall be effectively grounded. Unpowered equipment and enclosures shall be considered grounded where connected to an attached coaxial cable with an effectively grounded metallic shield.

(Information collection requirements contained in paragraph (b)(2) were approved by the Office of Management and Budget under control number: 1218–0130)

§ 1926.409–§ 1926.415. [Reserved]

Safety-Related Work Practices

§ 1926.416 General requirements.

(a) *Protection of employees.* (1) No employer shall permit an employee to work in such proximity to any part of an electric power circuit that the employee could contact the electric power circuit in the course of work, unless the employee is protected against electric shock by deenergizing the circuit and grounding it or by guarding it effectively by insulation or other means.

(2) In work areas where the exact location of underground electric powerlines is unknown, employees using jack-hammers, bars, or other hand tools which may contact a line shall be provided with insulated protective gloves.

(3) Before work is begun the employer shall ascertain by inquiry or direct observation, or by instruments, whether any part of an energized electric power circuit, exposed or concealed, is so located that the performance of the work may bring any person, tool, or machine into physical or electrical contact with the electric power circuit. The employer shall post and maintain proper warning signs where such a circuit exists. The employer shall advise employees of the location of such lines, the hazards involved, and the protective measures to be taken.

(b) *Passageways and open spaces.* (1) Barriers or other means of guarding shall be provided to ensure that workspace for electrical equipment will not be used as a passageway during periods when energized parts of electrical equipment are exposed.

(2) Working spaces, walkways, and similar locations shall be kept clear of cords so as not to create a hazard to employees.

(c) *Load ratings.* In existing installations, no changes in circuit protection shall be made to increase the load in excess of the load rating of the circuit wiring.

(d) *Fuses.* When fuses are installed or removed with one or both terminals energized, special tools insulated for the voltage shall be used.

(e) *Cords and cables.* (1) Worn or frayed electric cords or cables shall not be used.

(2) Extension cords shall not be fastened with staples, hung from nails, or suspended by wire.

§ 1926.417 Lockout and tagging of circuits.

(a) *Controls.* Controls that are to be deactivated during the course of work on energized or deenergized equipment or circuits shall be tagged.

(b) *Equipment and circuits.* Equipment or circuits that are deenergized shall be rendered inoperative and shall have tags attached at all points where such equipment or circuits can be energized.

(c) *Tags.* Tags shall be placed to identify plainly the equipment or circuits being worked on.

§ 1926.418–§ 1926.430 [Reserved]

Safety-Related Maintenance and Environmental Considerations

§ 1926.431 Maintenance of equipment.

The employer shall ensure that all wiring components and utilization equip-

ment in hazardous locations are maintained in a dust-tight, dust-ignition-proof, or explosion-proof condition, as appropriate. There shall be no loose or missing screws, gaskets, threaded connections, seals, or other impairments to a tight condition.

§ 1926.432 Environmental deterioration of equipment.

(a) *Deteriorating agents.* (1) Unless identified for use in the operating environment, no conductors or equipment shall be located:

(i) In damp or wet locations;

(ii) Where exposed to gases, fumes, vapors, liquids, or other agents having a deteriorating effect on the conductors or equipment; or

(iii) Where exposed to excessive temperatures.

(2) Control equipment, utilization equipment, and busways approved for use in dry locations only shall be protected against damage from the weather during building construction.

(b) *Protection against corrosion.* Metal raceways, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, fittings, supports, and support hardware shall be of materials appropriate for the environment in which they are to be installed.

§ 1926.433–§ 1926.440 [Reserved].

Safety Requirements for Special Equipment

§ 1926.441 Batteries and battery charging.

(a) *General requirements.* (1) Batteries of the unsealed type shall be located in enclosures with outside vents or in well ventilated rooms and shall be arranged so as to prevent the escape of fumes, gases, or electrolyte spray into other areas.

(2) Ventilation shall be provided to ensure diffusion of the gases from the battery and to prevent the accumulation of an explosive mixture.

(3) Racks and trays shall be substantial and shall be treated to make them resistant to the electrolyte.

(4) Floors shall be of acid resistant construction unless protected from acid accumulations.

(5) Face shields, aprons, and rubber gloves shall be provided for workers handling acids or batteries.

(6) Facilities for quick drenching of the eyes and body shall be provided within 25 feet (7.62 m) of battery handling areas.

(7) Facilities shall be provided for flushing and neutralizing spilled electrolyte and for fire protection.

(b) *Charging.* (1) Battery charging installations shall be located in areas designated for that purpose.

(2) Charging apparatus shall be protected from damage by trucks.

(3) When batteries are being charged, the vent caps shall be kept in place to avoid electrolyte spray. Vent caps shall be maintained in functioning condition.

§ 1926.442–§ 1926.448 [Reserved].

Definitions

§ 1926.449 Definitions applicable to this subpart.

The definitions given in this section apply to the terms used in Subpart K. The definitions given here for "approved" and "qualified person" apply, instead of the definitions given in § 1926.32, to the use of these terms in Subpart K.

Acceptable. An installation or equipment is acceptable to the Assistant Secretary of Labor, and approved within the meaning of this Subpart K:

(a) If it is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a qualified testing laboratory capable of determining the suitability of materials and equipment for installation and use in accordance with this standard; or

(b) With respect to an installation or equipment of a kind which no qualified testing laboratory accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another Federal agency, or by a State, municipal, or other local authority responsible for enforcing occupational safety provisions of the National Electrical Code, and found in compliance with those provisions; or

(c) With respect to custom-made equipment or related installations which are designed, fabricated for, and in-

tended for use by its manufacturer on the basis of test data which the employer keeps and makes available for inspection to the Assistant Secretary and his authorized representatives.

Accepted. An installation is "accepted" if it has been inspected and found to be safe by a qualified testing laboratory.

Accessible. (As applied to wiring methods.) Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building. (See *"concealed"* and *"exposed."*)

Accessible. (As applied to equipment.) Admitting close approach; not guarded by locked doors, elevation, or other effective means. (See *"Readily accessible."*)

Ampacity. The current in amperes a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

Appliances. Utilization equipment, generally other than industrial, normally built in standardized sizes or types, which is installed or connected as a unit to perform one or more functions.

Approved. Acceptable to the authority enforcing this Subpart. The authority enforcing this Subpart is the Assistant Secretary of Labor for Occupational Safety and Health. The definition of "acceptable" indicates what is acceptable to the Assistant Secretary of Labor, and therefore approved within the meaning of this Subpart.

Askarel. A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Askarels of various compositional types are used. Under arcing conditions the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases depending upon the askarel type.

Attachment plug (Plug cap)(Cap). A device which, by insertion in a receptacle, establishes connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.

Automatic. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as for example, a change in current strength, pressure, temperature, or mechanical configuration.

Bare conductor. See *"Conductor."*

Bonding. The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

Bonding jumper. A reliable conductor to assure the required electrical conductivity between metal parts required to be electrically connected.

Branch circuit. The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

Building. A structure which stands alone or which is cut off from adjoining structures by fire walls with all openings therein protected by approved fire doors.

Cabinet. An enclosure designed either for surface or flush mounting, and provided with a frame, mat, or trim in which a swinging door or doors are or may be hung.

Certified. Equipment is "certified" if it:

(a) Has been tested and found by a qualified testing laboratory to meet applicable test standards or to be safe for use in a specified manner, and

(b) Is of a kind whose production is periodically inspected by a qualified testing laboraotory. Certified equipment must bear a label, tag, or other record of certification.

Circuit breaker. (a) (600 volts nominal, or less.) A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without injury to itself when properly applied within its rating.

(b) (Over 600 volts, nominal.) A switching device capable of making, carrying, and breaking currents under normal circuit conditions, and also making, carrying for a specified time, and breaking currents under specified abnormal circuit conditions, such as those of short circuit.

Class I locations. Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explo-

sive or ignitible mixtures. Class I locations include the following:

(a) *Class I, Division 1.* A Class I, Division 1 location is a location:

(1) In which ignitible concentrations of flammable gases or vapors may exist under normal operating conditions; or

(2) In which ignitible concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

(3) In which breakdown or faulty operation of equipment or processes might release ignitible concentrations of flammable gases or vapors, and might also cause simultaneous failure of electric equipment.

NOTE: This classification usually includes locations where volatile flammable liquids or liquefied flammable gases are transferred from one container to another; interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used; locations containing open tanks or vats of volatile flammable liquids; drying rooms or compartments for the evaporation of flammable solvents; inadequately ventilated pump rooms for flammable gas or for volatile flammable liquids; and all other locations where ignitible concentrations of flammable vapors or gases are likely to occur in the course of normal operations.

(b) *Class I, Division 2.* A Class I, Division 2 location is a location:

(1) In which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the hazardous liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or

(2) In which ignitible concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operations of the ventilating equipment; or

(3) That is adjacent to a Class I, Division 1 location, and to which ignitible concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

NOTE: This classification usually includes locations where volatile flammable liquids or flammable gases or vapors are used, but which would become hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that merit consideration in determining the classification and extent of each location.

Piping without valves, checks, meters, and similar devices would not ordinarily introduce a hazardous condition even though used for flammable liquids or gases. Locations used for the storage of flammable liquids or of liquefied or compressed gases in sealed containers would not normally be considered hazardous unless also subject to other hazardous conditions.

Electrical conduits and their associated enclosures separated from process fluids by a single seal or barrier are classed as a Division 2 location if the outside of the conduit and enclosures is a nonhazardous location.

Class II locations. Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations include the following:

(a) *Class II, Division 1.* A Class II, Division 1 location is a location:

(1) In which combustible dust is or may be in suspension in the air under normal operating conditions, in quantities sufficient to produce explosive or ignitible mixtures; or

(2) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitible mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, operation of protective devices, or from other causes, or

(3) In which combustible dusts of an electrically conductive nature may be present.

NOTE: Combustible dusts which are electrically nonconducive include dusts produced in the handling and processing of grain and grain products, pulverized sugar and cocoa, dried egg and milk powders, pulverized spices, starch and pastes, potato and woodflour, oil meal from beans and seed, dried hay, and other organic materials which

may produce combustible dusts when processed or handled. Dusts containing magnesium or aluminum are particularly hazardous and the use of extreme caution is necessary to avoid ignition and explosion.

(b) *Class II, Division 2.* A Class II, Divison 2 location is a location in which:

(1) Combustible dust will not normally be in suspension in the air in quantities sufficient to produce explosive or ignitible mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus; or

(2) Dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment, and dust accumulations resulting therefrom may be ignitible by abnormal operation or failure of electrical equipment or other apparatus.

NOTE: This classification includes locations where dangerous concentrations of suspended dust would not be likely but where dust accumulations might form on or in the vicinity of electric equipment. These areas may contain equipment from which appreciable quantities of dust would escape under abnormal operating conditions or be adjacent to a Class II Division 1 location, as described above, into which an explosive or ignitible concentration of dust may be put into suspension under abnormal operating conditions.

(a) *Class III locations.* Class III locations are those that are hazardous because of the presence of easily ignitible fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. Class III locations include the following:

(a) *Class III, Division 1.* A Class III, Division 1 location is a location in which easily ignitible fibers or materials producing combustible flyings are handled, manufactured, or used.

NOTE: Easily ignitible fibers and flyings include rayon, cotton (including cotton linters and cotton waste), sisal or henequen, istle, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, sawdust, woodchips, and other materials of similar nature.

(b) *Class III, Division 2.* A Class III, Division 2 location is a location in which easily ignitible fibers are stored or handled, except in process of manufacture.

Collector ring. A collector ring is an assembly of slip rings for transferring electrical energy from a stationary to a rotating member.

Concealed. Rendered inaccessible by the structure or finish of the building. Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them. [See *"Accessible.* (As applied to wiring methods.)"]

Conductor—(a) *Bare.* A conductor having no covering or electrical insulation whatsoever.

(b) *Covered.* A conductor encased within material of composition or thickness that is not recognized as electrical insulation.

(c) *Insulated.* A conductor encased with material of composition and thickness that is recognized as electrical insulation.

Controller. A device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

Covered conductor. See *"Conductor."*

Cutout. (Over 600 volts, nominal.) An assembly of a fuse support with either a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link), or may act as the disconnecting blade by the inclusion of a nonfusible member.

Cutout box. An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box proper. (See *"Cabinet."*)

Damp location. See *"Location."*

Dead front. Without live parts exposed to a person on the operating side of the equipment.

Device. A unit of an electrical system which is intended to carry but not utilize electric energy.

Disconnecting means. A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

Disconnecting (or Isolating) switch. (Over 600 volts, nominal.) A mechanical switching device used for isolating a circuit or equipment from a source of power.

Dry location. See *"Location."*

Enclosed. Surrounded by a case, housing, fence or walls which will prevent persons from accidentally contacting energized parts.

Enclosure. The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts, or to protect the equipment from physical damage.

Equipment. A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like, used as a part of, or in connection with, an electrical installation.

Equipment grounding conductor. See *"Grounding conductor, equipment."*

Explosion-proof apparatus. Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor which may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and which operates at such an external temperature that it will not ignite a surrounding flammable atmosphere.

Exposed. (As applied to live parts.) Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts not suitably guarded, isolated, or insulated. (See *"Accessible."* and *"Concealed."*)

Exposed. (As applied to wiring methods.) On or attached to the surface or behind panels designed to allow access. [See *"Accessible.* (As applied to wiring methods.)"]

Exposed. (For the purposes of § 1926.408(d), Communication systems.) Where the circuit is in such a position that in case of failure of supports or insulation, contact with another circuit may result.

Externally operable. Capable of being operated without exposing the operator to contact with live parts.

Feeder. All circuit conductors between the service equipment, or the generator switchboard of an isolated plant, and the final branch-circuit overcurrent device.

Festoon lighting. A string of outdoor lights suspended between two points more than 15 feet (4.57 m) apart.

Fitting. An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function.

Fuse. (Over 600 volts, nominal.) An overcurrent protective device with a circuit opening fusible part that is heated and severed by the passage of overcurrent through it. A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or may not be the complete device necessary to connect it into an electrical circuit.

Ground. A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

Grounded. Connected to earth or to some conducting body that serves in place of the earth.

Grounded, effectively. (Over 600 volts, nominal.) Permanently connected to earth through a ground connection of sufficiently low impedance and having sufficient ampacity that ground fault current which may occur cannot build up to voltages dangerous to personnel.

Grounded conductor. A system or circuit conductor that is intentionally grounded.

Grounding conductor. A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.

Grounding conductor, equipment. The conductor used to connect the noncurrent-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor and/or the grounding electrode conductor at the service equipment or at the source of a separately derived system.

Grounding electrode conductor. The conductor used to connect the grounding electrode to the equipment ground-

ing conductor and/or to the grounded conductor of the circuit at the service equipment or at the source of a separately derived system.

Ground-fault circuit interrupter. A device for the protection of personnel that functions to deenergize a circuit or portion thereof within an established period of time when a current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach to a point of danger or contact by persons or objects.

Hoistway. Any shaftway, hatchway, well hole, or other vertical opening or space in which an elevator or dumbwaiter is designed to operate.

Identified (conductors or terminals). Identified, as used in reference to a conductor or its terminal, means that such conductor or terminal can be recognized as grounded.

Identified (for the use). Recognized as suitable for the specific purpose, function, use, environment, application, etc. where described as a requirement in this standard. Suitability of equipment for a specific purpose, environment, or application is determined by a qualified testing laboratory where such identification includes labeling or listing.

Insulated conductor. See *"Conductor."*

Interrupter switch. (Over 600 volts, nominal.) A switch capable of making, carrying, and interrupting specified currents.

Intrinsically safe equipment and associated wiring. Equipment and associated wiring in which any spark or thermal effect, produced either normally or in specified fault conditions, is incapable, under certain prescribed test conditions, of causing ignition of a mixture of flammable or combustible material in air in its most easily ignitible concentration.

Isolated. Not readily accessible to persons unless special means for access are used.

Isolated power system. A system comprising an isolating transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark or a qualified testing laboratory which indicates compliance with appropriate standards or performance in a specified manner.

Lighting outlet. An outlet intended for the direct connection of a lampholder, a lighting fixture, or a pendant cord terminating in a lampholder.

Listed. Equipment or materials included in a list published by a qualified testing laboratory whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

Location—(a) *Damp location.* Partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements.

(b) *Dry location.* A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.

(c) *Wet location.* Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids, such as locations exposed to weather and unprotected.

Mobile X-ray. X-ray equipment mounted on a permanent base with wheels and/or casters for moving while completely assembled.

Motor control center. An assembly of one or more enclosed sections having a common power bus and principally containing motor control units.

Outlet. A point on the wiring system at which current is taken to supply utilization equipment.

Overcurrent. Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload (see definition), short circuit, or ground fault. A current in excess of rating may be accommodated

by certain equipment and conductors for a given set of conditions. Hence the rules for overcurrent protection are specific for particular situations.

Overload. Operation of equipment in excess of normal, full load rating, or of a conductor in excess of rated ampacity which, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload. (See *"Overcurrent."*)

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel; including buses, automatic overcurrent devices, and with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall or partition and accessible only from the front. (See *"Switchboard."*)

Portable X-ray. X-ray equipment designed to be hand-carried.

Power fuse. (Over 600 volts, nominal.) See *"Fuse."*

Power outlet. An enclosed assembly which may include receptacles, circuit breakers, fuseholders, fused switches, buses and watt-hour meter mounting means; intended to serve as a means for distributing power required to operate mobile or temporarily installed equipment.

Premises wiring system. That interior and exterior wiring, including power, lighting, control, and signal circuit wiring together with all of its associated hardware, fittings, and wiring devices, both permanently and temporarily installed, which extends from the load end of the service drop, or load end of the service lateral conductors to the outlet(s). Such wiring does not include wiring internal to appliances, fixtures, motors, controllers, motor control centers, and similar equipment.

Qualified person. One familiar with the construction and operation of the equipment and the hazards involved.

Qualified testing laboratory. A properly equipped and staffed testing laboratory which has capabilities for and which provides the following services:

(a) Experimental testing for safety of specified items of equipment and materials referred to in this standard to determine compliance with appropriate test standards or performance in a specified manner;

(b) Inspecting the run of such items of equipment and materials at factories for product evaluation to assure compliance with the test standards;

(c) Service-value determinations through field inspections to monitor the proper use of labels on products and with authority for recall of the label in the event a hazardous product is installed;

(d) Employing a controlled procedure for identifying the listed and/or labeled equipment or materials tested; and

(e) Rendering creditable reports or findings that are objective and without bias of the tests and test methods employed.

Raceway. A channel designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this subpart. Raceways may be of metal or insulating material, and the term includes rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquid tight flexible metal conduit, flexible metallic tubing, flexible metal conduit, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

Readily accessible. Capable of being reached quickly for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc. (See *"Accessible."*)

Receptacle. A receptacle is a contact device installed at the outlet for the connection of a single attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is a single device containing two or more receptacles.

Receptacle outlet. An outlet where one or more receptacles are installed.

Remote-control circuit. Any electric circuit that controls any other circuit through a relay or an equivalent device.

Sealable equipment. Equipment en-

closed in a case or cabinet that is provided with a means of sealing or locking so that live parts cannot be made accessible without opening the enclosure. The equipment may or may not be operable without opening the enclosure.

Separately derived system. A premises wiring system whose power is derived from generator, transformer, or converter windings and has no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

Service. The conductors and equipment for delivering energy from the electricity supply system to the wiring system of the premises served.

Service conductors. The supply conductors that extend from the street main or from transformers to the service equipment of the premises supplied.

Service drop. The overhead service conductors from the last pole or other aerial support to and including the splices, if any, connecting to the service-entrance conductors at the building or other structure.

Service-entrance conductors, overhead system. The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop.

Service-entrance conductors, underground system. The service conductors between the terminals of the service equipment and the point of connection to the service lateral. Where service equipment is located outside the building walls, there may be no service-entrance conductors, or they may be entirely outside the building.

Service equipment. The necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories, located near the point of entrance of supply conductors to a building or other structure, or an otherwise defined area, and intended to constitute the main control and means of cutoff of the supply.

Service raceway. The raceway that encloses the service-entrance conductors.

Signaling circuit. Any electric circuit that energizes signaling equipment.

Switchboard. A large single panel, frame, or assembly of panels which have switches, buses, instruments, overcurrent and other protective devices mounted on the face or back or both. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets. (See *"Panelboard."*)

Switches—(a) *General-use switch.* A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage.

(b) *General-use snap switch.* A form of general-use switch so constructed that it can be installed in flush device boxes or on outlet box covers, or otherwise used in conjunction with wiring systems recognized by this subpart.

(c) *Isolating switch.* A switch intended for isolating an electric circuit from the source of power. It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means.

(d) *Motor-circuit switch.* A switch, rated in horsepower, capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.

Switching devices. (Over 600 volts, nominal.) Devices designed to close and/or open one or more electric circuits. Included in this category are circuit breakers, cutouts, disconnecting (or isolating) switches, disconnecting means, and interrupter switches.

Transportable X-ray. X-ray equipment installed in a vehicle or that may readily be disassembled for transport in a vehicle.

Utilization equipment. Utilization equipment means equipment which utilizes electric energy for mechanical, chemical, heating, lighting, or similar useful purpose.

Utilization system. A utilization system is a system which provides electric power and light for employee workplaces, and includes the premises wiring system and utilization equipment.

Ventilated. Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes, or vapors.

Volatile flammable liquid. A flammable liquid having a flash point below 38 degrees C (100 degrees F) or whose temperature is above its flash point, or a Class II combustible liquid having a vapor pressure not exceeding 40 psia (276 kPa) at 38° C (100° F) whose temperature is above its flash point.

Voltage. (Of a circuit.) The greatest root-mean-square (effective) difference of potential between any two conductors of the circuit concerned.

Voltage, nominal. A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (as 120/240, 480Y/277, 600, etc.). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Voltage to ground. For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit.

Watertight. So constructed that moisture will not enter the enclosure.

Weatherproof. So constructed or protected that exposure to the weather will not interfere with successful operation. Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust, or temperature extremes, are not a factor.

Wet location. See *"Location."*

Subpart L—Ladders and Scaffolding

§ 1926.450 Ladders.

(a) *General requirements.* (1) Except where either permanent or temporary stairways or suitable ramps or runways are provided, ladders described in this subpart shall be used to give safe access to all elevations.

(2) The use of ladders with broken or missing rungs or steps, broken or split side rails, or other faulty or defective construction is prohibited. When ladders with such defects are discovered, they shall be immediately withdrawn from service. Inspection of metal ladders shall include checking for corrosion of interiors of open end hollow rungs.

(3) Manufactured portable wood ladders provided by the employer shall be in accordance with the provisions of the American National Standards Institute, A 14.1-1968, Safety Code for Portable Wood Ladders.

(4) Portable metal ladders shall be of strength equivalent to that of wood ladders. Manufactured portable metal ladders provided by the employer shall be in accordance with the provisions of the American National Standards Institute, A 14.2-1956, Safety Code for Portable Metal Ladders.

(5) Fixed ladders shall be in accordance with the provisions of the American National Standards Institute, A 14.3-1956, Safety Code for Fixed Ladders.

(6) Portable ladder feet shall be placed on a substantial base, and the area around the top and bottom of the ladder shall be kept clear.

(7) Portable ladders shall be used at such a pitch that the horizontal distance from the top support to the foot of the ladder is about one-quarter of the working length of the ladder (the length along the ladder between the foot and the top support). Ladders shall not be used in a horizontal position as platforms, runways, or scaffolds.

(8) Ladders shall not be placed in passageways, doorways, driveways, or any location where they may be displaced by activities being conducted on any other work, unless protected by barricades or guards.

(9) The side rails shall extend not less than 36 inches above the landing. When this is not practical, grab rails, which provide a secure grip for an employee moving to or from the point of access, shall be installed.

(10) Portable ladders in use shall be tied, blocked, or otherwise secured to prevent their being displaced.

(11) Portable metal ladders shall not be used for electrical work or where they may contact electrical conductors.

(b) *Job-made ladders.* (1) Job-made ladders shall be constructed for intended use. If a ladder is to provide

Appendix F

Levels of Personal Protection

Appendix F

Levels of Personal Protection

LEVEL A—To be selected when the greatest level of skin, respiratory, and eye protection is required.

Level A equipment; used as appropriate.

1. Pressure-demand, full face-piece self-contained breathing apparatus (SCBA), or pressure-demand supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).
2. Totally encapsulating chemical-protective suit.
3. Coveralls.*
4. Long underwear.*
5. Gloves, outer, chemical-resistant.
6. Gloves, inner, chemical-resistant.
7. Boots, chemical-resistant, steel toe and shank.
8. Hard hat (under suit).*
9. Disposable protective suit, gloves and boots (Depending on suit construction, may be worn over totally encapsulating suit).
10. Two-way radios (worn inside encapsulating suit).

*Optional, as applicable.

LEVEL B—The highest level of respiratory protection is necessary, but a lesser level of skin protection is needed.

Level B equipment; used as appropriate.

1. Pressure-demand, full-face piece self-contained breathing apparatus (SCBA), or pressure-demand supplied air respirator with escape SCBA (NIOSH approved).
2. Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls.*
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical resistant.
6. Boots, outer, chemical-resistant steel toe and shank.

7. Boot-covers, outer, chemical resistant (disposable).*
8. Hard hat.
9. Two-way radios (worn inside encapsulating suit).
10. Face shield.*

*Optional, as applicable.

LEVEL C—The concentrations(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met.

Level C equipment; used as appropriate.

1. Full-face or half-mask, air purifying, canister equipped respirators (NIOSH approved).
2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls.*
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical resistant.
6. Boots, outer, chemical-resistant steel toe and shank.*
7. Boot-covers, outer, chemical resistant (disposable).*
8. Hard hat.
9. Escape mask.*
10. Two-way radios (worn under outside protective clothing).
11. Face shield.*

*Optional, as applicable.

LEVEL D—A work uniform affording minimal protection: used for nuisance contamination only.

1. Coveralls.
2. Gloves.*
3. Boots/shoes, chemical-resistant steel toe and shank.
4. Boots, outer, chemical-resistant (disposable).*
5. Safety glasses or chemical splash goggles.*
6. Hard hat.
7. Escape mask.*
8. Face shield.*

*Optional as applicable.

The types of hazards for which levels A, B, C, and D protection are appropriate are described below:

Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin,
2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible, or
3. Operations must be conducted in confined, poorly ventilated areas and the absence of conditions requiring Level A have not yet been determined.

Level B protection should be used when:

1. The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection.

   NOTE: This involves atmospheres with IDLH concentrations of specific substances that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.
2. The atmosphere contains less than 19.5 percent oxygen, or
3. The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin.

Level C protection should be used when:

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin,
2. The types of air contaminants have been identified, concentrations measured, and a canister respirator is available that can remove the contaminants, and
3. All criteria for the use of air-purifying respirators are met.

Level D protection should be used when:

1. The atmosphere contains no hazard, and
2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

   NOTE: As stated before combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

Appendix G

DOE Explosives Safety Manual Waiver

DOE EXPLOSIVES SAFETY MANUAL WAIVER

LLNL WAIVER NO: 97-12 **Issued:** 05/01/97

Expires: 05/01/00

1. **Operation, Area or Building Involved:** Explosives Facilities at Site 300

2. **Responsible Supervisor:** John J. Greci

3. **Specific Standard Requiring Waiver:** Section II, Paragraph 3.2c, states that "Maintenance or construction operations performed by non-DOE facility personnel.... should be at least intraline distance from any building containing explosives."

4. **Description of Condition Not in Compliance:** Non-DOE Contractor personnel will be routinely conducting Environmental Restoration Division (ERD) activities, sampling of wells, etc., within intraline distance of various facilities containing explosives throughout Site 300.

5. **Alternate Safety Measures Existing or Proposed:** Non-DOE contractor personnel shall attend HS-2080, Explosives Safety Orientation for Crafts, Protective Force Division and Fire Personnel before they are allowed to conduct ERD environmental activities within intraline distance of buildings containing explosives. When non-DOE contractor personnel must enter the Process Area, Chemistry Area, Weaponization Test Areas, East or West Firing Areas, Waste Treatment Area or work near any magazine or facility containing explosives, the contractor shall notify the ERD Sampling Coordinator or ERD Site Safety Officer (SSO). The Sampling Coordinator or SSO will contact the appropriate Site 300 Explosives Area and/or Facility Supervisor and request access to the area. The Site 300 Area /Facility Supervisor may grant access to the area and allow non-DOE contractor personnel to conduct ERD environmental operations within intraline distance of their explosives facilities provided no explosives operations are to be done while the ERD environmental work is taking place. Non-DOE contractor personnel shall leave the area within intraline distance of an explosives facility prior to any explosives operations being started. If it becomes necessary to conduct explosives operations while ERD environmental activities are taking place, the specific Site 300 Area/Facility Supervisor shall be responsible for clearing the area of non-DOE contractor personnel.

6. **Why Compliance Will Not Be Reached:** There are many ground water monitoring wells within intraline distance of various explosives operating and storage facilities throughout Site 300. Compliance with the suggested controls in the DOE Explosives Safety Manual would require all explosives to be removed from each explosives facility prior to ERD environmental activities within intraline distance of that facility. Site 300 does not have the storage capacity (facilities) that would permit the removal of the explosives from the affected buildings. Strict compliance with the

alternate safety measures should reduce the chances of a serious incident to an acceptable level.

7. Risk Assessment: The probability that an incident will occur based on non-compliance with the suggested controls in the Explosives Safety Manual is low. The maximum credible event would be a detonation of 10,000 pounds of 1.1 explosives. Death or serious injury to personnel within the intraline distance of the detonation could occur from fragments, debris, firebrands, or other objects.

8. Other Comments: None

REVIEWED:

Facility Manager, B-Division Site 300

Facility & Operations Manager, C&MS Site 300

Facility Manager, DTED Site 300

Facility Manager, MM Site 300

ERD Project Manager, Site 300

EH&S Team 1 Explosives Safety

APPROVED:

Plant Manager

Site 300 Manager
FOR M.L. GRISSOM

THIS WAIVER DOES NOT PROVIDE ANY PHYSICAL PROTECTION

ADDITIONAL REVIEWS:

LLNL WAIVER NO: 97-12

Firing Table Supervisor

Firing Table Supervisor

Chemistry Area Supervisor

DTED Supervisor

ERD Sampling Supervisor

ERD Site 300 Safety Oficer

cc:
ES&H Team 1 Explosives Safety (Original)
DOE Oakland
Each signatory

THIS WAIVER DOES NOT PROVIDE ANY PHYSICAL PROTECTION