APPENDIX B

SITE HEALTH AND SAFETY PLAN
RI/FS HEALTH AND SAFETY PLAN
SUSSEX COUNTY LANDFILL NO. 5
LAUREL, DELAWARE

29 May 1992

Prepared by:
Roy F. Weston, Inc.
1 Weston Way
West Chester, Pennsylvania 19380
REVIEW/APPROVAL DOCUMENTATION

1) Project Director

[Signature]
Name
Signature
Date
5/29/92

2) Project Manager

[Signature]
Name
Signature
Date
5/29/92

3) Division Health and Safety

[Signature]
Name
Signature
Date
5/29/92

4) Site Health and Safety Coordinator

[Signature]
Name
Signature
Date
5/29/92

5) Corporate Health and Safety

[Signature]
Name
Signature
Date
5/29/92
EMERGENCY CONTACTS

Primary Emergency Contacts

The following emergency contacts are available in the event of an emergency. Additional emergency numbers are listed in Subsection 6.2.

<table>
<thead>
<tr>
<th>Contact</th>
<th>Location/Name</th>
<th>Telephone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Department</td>
<td>Laurel Fire Department</td>
<td>302-875-3081 or 911</td>
</tr>
<tr>
<td>Police</td>
<td>Laurel Police Department</td>
<td>302-875-2244 or 911</td>
</tr>
<tr>
<td>Medical Facility</td>
<td>Nanticoke Memorial Hospital</td>
<td>302-629-6611</td>
</tr>
<tr>
<td>(24-hour emergency)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sussex County Paramedics</td>
<td>Seaford Unit</td>
<td>911</td>
</tr>
<tr>
<td>WESTON Health and Safety</td>
<td>George Crawford</td>
<td>215-430-7406</td>
</tr>
<tr>
<td>WESTON 24-Hour Toxicological Service</td>
<td></td>
<td>513-421-3063</td>
</tr>
</tbody>
</table>

Location of Medical Facility

Figure A indicates the location of the closest medical facility.

Directions to Nanticoke Memorial Hospital, 801 Middleford Road, Seaford, Delaware:

From Laurel Landfill, take Route 494 east to Route 24. Follow Route 24 East to Route 13 in Laurel. Take Route 13 North to Seaford. Turn left at the second traffic light in Seaford onto Middleford Road. Hospital is approximately one-half mile on the left.

Secondary Emergency Contacts

After the emergency situation has stabilized and the proper emergency personnel have been contacted, the designated Site Health and Safety Coordinator (SHSC) will notify the following WESTON personnel:

<table>
<thead>
<tr>
<th>Contact</th>
<th>Title</th>
<th>Telephone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abe Thomas</td>
<td>WESTON Project Director</td>
<td>215-430-3044</td>
</tr>
<tr>
<td>Tom Drew</td>
<td>WESTON Project Manager</td>
<td>215-430-7302</td>
</tr>
<tr>
<td></td>
<td></td>
<td>215-692-4190</td>
</tr>
<tr>
<td>George Crawford</td>
<td>Corporate H&amp;S Officer</td>
<td>215-430-7406</td>
</tr>
<tr>
<td>(24-hour emergency)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Michael Izzo</td>
<td>Project Manager for Sussex County, Point of Contact</td>
<td>302-855-7703</td>
</tr>
</tbody>
</table>
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<td>Hazardous Materials Use and Storage</td>
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<td>Biological Hazards</td>
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<td>PERSONNEL PROTECTION</td>
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<td>Levels of Protection</td>
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</tr>
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<td>5.2</td>
<td>Personnel Monitoring: Organics</td>
<td>5-4</td>
</tr>
<tr>
<td>5.2.1</td>
<td>Organic Action Levels</td>
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<td>5.3</td>
<td>Personnel Monitoring: Explosives Atmospheres/Oxygen Deficiencies</td>
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<tr>
<td>5.3.1</td>
<td>Action Levels: Explosimeter</td>
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<tr>
<td>5.3.2</td>
<td>Action Levels: Oxygen Meter</td>
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<td>Work Area Control Techniques</td>
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<td>5.5</td>
<td>General Safety Guidelines</td>
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<td>5.6</td>
<td>Personnel Decontamination</td>
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<td>5.7</td>
<td>Equipment Decontamination</td>
<td>5-8</td>
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<td>6</td>
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<td>Emergency Contacts</td>
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<td>6.3</td>
<td>Emergency Equipment On-Site</td>
<td>6-2</td>
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<tr>
<td>6.4</td>
<td>Emergency Contingency Plan</td>
<td>6-3</td>
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<tr>
<td>6.4.1</td>
<td>Implementation</td>
<td>6-3</td>
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<td>6.4.2</td>
<td>Emergency Response Procedures</td>
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<td>6.4.3</td>
<td>Evacuation Plan</td>
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<td>6.4.4</td>
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<td>FIELD PERSONNEL SIGN-OFF</td>
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SECTION 1

INTRODUCTION

The purpose of this Health and Safety Plan (HSP) is to define specific procedures and protocols that will be implemented to ensure the health and safety of all field personnel during field activities related to RI/FS investigations at Sussex County Landfill No. 5, Laurel, Delaware. This HSP is designed to complement, and draws from information contained in, the RI/FS Work Plan and Sampling and Analysis Plan (SAP) prepared by Roy F. Weston, Inc. (WESTON).

A copy of the HSP will be provided to each subcontractor, and a copy will be available at each work location. As stated previously, this HSP applies to all subcontractors of WESTON and all subcontractors to WESTON subcontractors. In addition, visitors to WESTON work locations will also be required to follow WESTON health and safety protocols. Any deviations from the WESTON HSP or program will be noted in WESTON’s Health and Safety Log. Consideration was given to the following references during development of this plan:

- WESTON health and safety operating practices.
- Threshold Limit Values and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (ACGIH), 1991-1992.
- Construction Standards, Department of Labor, 1989a.
- General Industry Standards, Department of Labor, 1989b.
- Registry of Toxic Effects of Chemical Substances, NIOSH, 1985.
- Environmental Response Team Operating Guidelines.
- NIOSH Pocket Guide to Chemical Hazards.
- RI/FS Sampling and Analysis Plan, Sussex County Landfill No. 5, WESTON, December 1991.
SECTION 2

HEALTH AND SAFETY RESPONSIBILITIES

WESTON will assign one individual to serve as Site Health and Safety Coordinator (SHSC) during each portion of scheduled field activities. That individual will be responsible for ensuring that all personnel and activities are in conformance with the protocols defined in this document. The SHSC will have complete control over health and safety matters for the field activity. He or she may at any time stop a field activity if health and safety procedures are being compromised or are not sufficient. The SHSC will maintain direct contact with WESTON’s Corporate Health and Safety Director.

If more than one field crew is required, one member from each crew will be assigned as the Field Safety Officer (FSO). The FSOs will have responsibility for health and safety compliance at each work location and will maintain contact with the SHSC.

WESTON’s Corporate Health and Safety Director is ultimately responsible for ensuring that corporate health and safety programs are followed by all WESTON employees and subcontractors. In regard to work at Laurel Landfill, the Corporate Health and Safety Director will review and approve this document. The Project Health and Safety Coordinator, under the jurisdiction of the Director, will serve an audit function to ensure that the defined protocols are being implemented during field activities.
Other individuals responsible for the project's HSP include the Project Manager, and the Project Director. The ultimate responsibility for project health and safety lies with the Project Director. In fulfillment of this responsibility, the Project Manager and the Project Director lend their support to health and safety programs. Their support will be manifested by approving this HSP and by emphasizing the successful and safe completion of the project.
3.1 MEDICAL MONITORING

In compliance with OSHA standards, all WESTON personnel will be enrolled in a medical monitoring program. The medical status of all WESTON personnel is monitored through an annual physical examination. Medical results and monitoring data for WESTON personnel are reviewed by an independent oversight group, Washington Occupational Health Associates, Inc., Washington, DC. All subcontractor personnel will be required to have a medical monitoring program in place and must be certified by a licensed physician to be medically fit to wear respiratory protection and to work at hazardous waste sites. The specific test parameters of the WESTON medical exam are as follows:

- Medical and exposure history questionnaire.
- Physical examination by physician.
- Vitals: height, weight, blood pressure, pulse.
- Audiometric test and questionnaire (0.5K, 1K, 2K, 3K, 4K, 6K, and 8K Hz levels).
- Pulmonary function test (FVC and FEV1).
- Visual acuity test.
- Resting electrocardiogram (12 lead).
3.2 PERSONNEL TRAINING

All WESTON personnel are required to attend the Roy F. Weston, Inc. "Hazardous Incidents Response Operations Course" in compliance with 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response." This is currently a 40-hour training course. Individuals who, prior to 1987, attended WESTON's 24- or 32-hour training courses meet the 40-hour requirement based on "grandfathering" of previous experience. These courses certify WESTON personnel to perform various activities in potentially hazardous locations in EPA-designated levels of protection B and C. Additionally WESTON personnel are required to attend an 8-hour health and safety refresher course.

To serve as an SHSC an individual must have additional training (8 hours), 24 hours of documented work experience in the prescribed level of protection with direct supervision from an experienced person, and final approval by WESTON's Corporate Health and Safety Director.

In addition, the SHSC holds current first aid and CPR certifications.
Prior to commencement of site activities at the landfill site, all personnel and subcontractors will attend a project-specific Health and Safety Orientation. The purpose of this training will be to familiarize project personnel with project-specific hazards, to ensure compliance with the HSP, and to fulfill "right-to-know" regulations. The contents of this training will include the following:

- Potential chemical hazards.
- Potential physical hazards.
- Levels of protection.
- Decontamination procedures.
- Emergency procedures/telephone numbers.
- Directions to the nearest medical facilities.
- Health and safety chain of command.
- Respiratory protection checkout procedures.
- Fire safety rules.

3.3 SUBCONTRACTORS

All subcontractors to WESTON will be required to comply with WESTON standards as a minimum. In addition, they must follow all pertinent federal, state, and local health and safety standards.

The following information must be supplied by each subcontractor to WESTON:

- A general statement indicating that the subcontractor's health and safety program is in compliance with applicable sections of 29 CFR 1910 and 1926. Specifically, the statement must identify that the subcontractor's employees are aware of and that the subcontractor is in compliance with the intent of OSHA standard 1910.120, "Hazardous Waste Operations and Emergency Response."

- A statement indicating that all employees who will or may take part in operations during the Laurel Landfill RI field activities are enrolled in and current with respect to a medical monitoring program that complies with OSHA standards.
A statement indicating that the subcontractor will provide protective equipment for its own employees.

A statement indicating that the subcontractor and its employees will follow WESTON’s HSP and that they will cooperate with WESTON’s SHSC.

A matrix or listing of each employee who will or may be involved with the Laurel Landfill RI/FS project. This list should include the following information for each employee:

- Name.
- Employment start date.
- Date of last medical examination (certified fit to wear respiratory protection and to work on hazardous waste sites).
- Health and safety training certificates and dates (specify duration of training).
- Documentation of qualitative fit testing with respirators to be used.
- Experience in levels of protection (hours, weeks).
- Years working in the field (drilling experience).

### 3.4 EXPOSURE/INJURY REPORTS

In the case of an injury or exposure to hazardous substances, an incident report will be filed within 5 days with WESTON’s Corporate Health and Safety Director. A copy of that report will also be filed with the Project Director and the Project Manager. A copy of the WESTON Exposure/Injury Report form and WESTON’s memorandum including reporting times and responsibilities is presented in Appendix A.

If an injury or exposure to hazardous substances occurs, the specific incident will be reported to the SHSC. The SHSC will immediately notify WESTON’s Corporate Health and Safety Director.
The SHSC will ensure that Exposure/Injury Reports are completed. After reviewing an Exposure/Injury Report, WESTON’s Corporate Health and Safety Department will investigate and recommend follow-up actions to be conducted to ensure that preventive measures are implemented.
4.1 PRIMARY CHEMICALS OF POTENTIAL CONCERN

Table 4-1 lists the chemical contaminants of primary health and safety concern that could potentially be encountered during RI/FS activities at Laurel Landfill, along with relevant exposure limits and acute health effects. The following general procedures should be followed if symptoms of exposure occur:

- If inhalation occurs, remove to fresh air.
- If not breathing, provide artificial respiration.
- In case of contact, immediately flush area with water for at least 15 minutes while removing any contaminated clothing.
- In all cases where an exposure has taken place, a physician will be contacted and an incident/injury report will be completed.

This list was generated by analyzing previous sampling data obtained during groundwater investigations conducted from May 1985 through October 1990. Groundwater sampling at the Laurel Landfill site has included both site monitor wells and nearby residential wells located downgradient of the site. Material Safety Data Sheets (MSDS) will be obtained and attached to the HSP (Appendix B).
Table 4-1
Primary Chemicals of Potential Concern, Exposure Limits, and Acute Health Effects,
Sussex County Landfill No. 5, Laurel, DE

<table>
<thead>
<tr>
<th>Chemical of Potential Concern</th>
<th>Standards/Criteria*</th>
<th>IDLH</th>
<th>Exposure Route</th>
<th>Symptoms of Acute Exposure</th>
<th>Physical Properties</th>
<th>Reactivity/Incompatible With</th>
<th>Relevant Instrumental Information**</th>
</tr>
</thead>
</table>
| VOCs Acetone                  | REL 250 ppm         | 20,000 ppm | I               | Irritated eyes, nose, and throat; headache; dizziness; dermatitis | FP = 1.4°F  
     LEL = 2.6%  
     UEL = 12.8%  
     State = liquid  
     VP = 266 mm at 77°F  
     VD = 2.00 | Oxidizing material; acids  
     IP = 9.69 eV  
     HNu (10.2 eV) = 63%  
     OVA = 60% |
| benzene                       | TLV 10 ppm PEL 1 ppm STEL 5 ppm REL 0.1 ppm | 3,000 ppm | I               | Irritated eyes, nose, and respiratory system; giddiness; headache; nausea; fatigue; depression; abdominal pain | FP = 12°F  
     LEL = 1.3%  
     UEL = 1.1%  
     State = liquid  
     VP = 100 mm at 79°F  
     VD = 2.77 | Strong oxidizers; chlorine; bromine with iron  
     IP = 9.25 eV  
     HNu (10.2 eV) = 100%  
     OVA = 150% |
| 2-Butanone                    | PEL 200 ppm STEL 300 ppm | 3,000 ppm | I               | Irritated eyes, nose; headache; dizziness; vomiting | FP = 21°F  
     LEL = 2%  
     UEL = 10%  
     State = liquid Other | Very strong oxidizers  
     IP = 9.53 eV  
     HNu (10.2 eV) = 57%  
     OVA = 80% |
| Chlorobenzene                 | PEL 75 ppm           | 2,400 ppm | I               | Irritated eyes, nose, and skin; drowsiness | FP = 84°F  
     LEL = 1.3%  
     UEL = 7.1%  
     State = liquid | Strong oxidizers  
     IP = 9.07 eV  
     OVA = 200% |
| Chloroform (Trichloromethane) | PEL 2 ppm            | 2,000 ppm | I               | Dizziness; mental dullness | FP = NA  
     LEL = NA  
     UEL = NA  
     State = liquid | Strong caustics; chemically active metals  
     IP = 11.42 eV  
     HNu (11.7 eV) = 60%  
     OVA = 65% |
Table 4-1, Continued

<table>
<thead>
<tr>
<th>Chemical of Potential Concern</th>
<th>Standards/Criteria*</th>
<th>IDLH</th>
<th>Exposure Route</th>
<th>Symptoms of Acute Exposure</th>
<th>Physical Properties</th>
<th>Reactivity/Incompatible With</th>
<th>Relevant Instrumental Information**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloromethane</td>
<td>PEL 50 ppm STEL 100 ppm</td>
<td>Ca 10,000 ppm</td>
<td>I C</td>
<td>Dizziness; nausea; vomiting; staggering; slurred speech; convulsions; coma; liver, kidney damage; frostbite</td>
<td>FP = NA (gas) LEL = 8.1% UEL = 17.4% State = gas VP = &gt; 1 atm VD = &lt; 1</td>
<td>Chemically active metals; water</td>
<td>IP = 11.28 eV</td>
</tr>
<tr>
<td>Chloroethane</td>
<td>PEL 1000 ppm</td>
<td>20,000 ppm</td>
<td>I G C</td>
<td>Incoordination; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver, kidney damage</td>
<td>FP = NA (gas) LEL = 3.8% UEL = 15.4% State = gas VP = &gt; 1 atm VD = &gt; 1</td>
<td>Chemically active metals; oxidizers; water or steam</td>
<td>IP = 10.97 eV</td>
</tr>
<tr>
<td>1,4-Dichlorobenzene</td>
<td>PEL 75 ppm STEL 110 ppm</td>
<td>Ca 1,000 ppm</td>
<td>I G C</td>
<td>Irritated eyes; headache; nausea; vomiting</td>
<td>FP = 150°F LEL = 2.5% UEL = 7 State = liquid</td>
<td>None</td>
<td>IP = 8.94 eV</td>
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<tr>
<td>1,1-Dichloroethane</td>
<td>TLV 200 ppm PEL 100 ppm</td>
<td>4,000 ppm</td>
<td>I G C</td>
<td>Central nervous system depression, skin irritation, drowsiness, unconsciousness</td>
<td>FP = 17°F LEL = 6% UEL = 16% State = liquid VP = 230 mm at 77°F VD = 3.44</td>
<td>Strong oxidizers, strong caustics</td>
<td>OVA = 80% IP = 11.6 eV HNUNa = NA</td>
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<tr>
<td>1,2-Dichloropropane</td>
<td>PEL 75 ppm Ca STEL 110 ppm</td>
<td>Ca 2,000 ppm</td>
<td>I G C</td>
<td>Eye irritation; drowsiness, light-headedness; skin irritation</td>
<td>FP = 60°F LEL = 3.4% UEL = 14.5% State = liquid VP = 40 mm VD = &gt;1</td>
<td>Strong oxidizers, strong acids</td>
<td>IP = 10.87 eV</td>
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<tr>
<td>Ethylbenzene</td>
<td>TLV and PEL 100 ppm STEL 125 ppm</td>
<td>2,000 ppm</td>
<td>I G C</td>
<td>Irritated eyes and mucous membranes; headache; dermatitis</td>
<td>FP = 59°F LEL = 1.0% UEL = 6.7% State = liquid VP = 10 mm at 78°F VD = 3.66</td>
<td>Strong oxidizers</td>
<td>IP = 8.76 eV OVA = 100%</td>
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<tr>
<td>Chemical of Potential Concern</td>
<td>Standards/ Criteria*</td>
<td>IDLH</td>
<td>Exposure Route</td>
<td>Symptoms of Acute Exposure</td>
<td>Physical Properties</td>
<td>Reactivity/Incompatible With</td>
<td>Relevant Instrumental Information**</td>
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<tr>
<td>4-Methyl-2-pentanone (MIBK)</td>
<td>TLV and PEL 50 ppm STEL 75 ppm</td>
<td>3,000 ppm</td>
<td>I G C</td>
<td>Irritated eyes and mucous membranes; headache</td>
<td>FP = 64°F LEL = 1.2% UEL = 8.0% State = liquid VP = 16 mm at 68°F VD = 3.45</td>
<td>Strong oxidizers</td>
<td>OVA = 80% IP = 9.30</td>
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<tr>
<td>Tetrachloroethylene</td>
<td>TLV 50 ppm PEL 25 ppm STEL 200 ppm</td>
<td>Ca 500 ppm</td>
<td>I G C</td>
<td>Irritated eyes, nose and throat; nausea; flushed face; vertigo; dizziness</td>
<td>FP = NA LEL = NA UEL = NA State = liquid VP = 15.8 mm at 72°F VD = 5.83</td>
<td>Strong oxidizers; chemically active metals</td>
<td>IP = 9.32 eV OVA = 100%</td>
</tr>
<tr>
<td>Methane</td>
<td>NA</td>
<td>NA</td>
<td>I</td>
<td>Simple asphyxiant</td>
<td>FP = -82.25°F LEL = 5.53% UEL = 14% State = Gas VD = 0.554</td>
<td></td>
<td>IP = 12.98</td>
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<tr>
<td>Toluene</td>
<td>TLV 100 ppm PEL 100 ppm STEL 150 ppm</td>
<td>2,000 ppm</td>
<td>I G C S</td>
<td>Fatigue; weakness; confusion; dizziness; headache; insomnia; dermatitis</td>
<td>FP = 40°F LEL = 1.3% UEL = 7.1% State = liquid VP = 36.7 mm at 86°F VD = 3.14</td>
<td>Strong oxidizers</td>
<td>IP = 8.82 eV OVA = 100%</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>REL 25 ppm TLV 50 ppm PEL 50 ppm STEL 200 ppm</td>
<td>Ca 1,000 ppm</td>
<td>I G C</td>
<td>Irritated eyes; headache; vertigo; visual distortion; tremors; nausea; vomiting</td>
<td>FP = NA LEL = 11% UEL = 41% State = liquid VP = 100 mm at 90°F VD = 4.53</td>
<td>Strong caustics; chemically active metals</td>
<td>IP = 9.47 eV OVA = 70%</td>
</tr>
<tr>
<td>Chemical of Potential Concern</td>
<td>Standards/ Criteria*</td>
<td>IDLH</td>
<td>Exposure Route</td>
<td>Symptoms of Acute Exposure</td>
<td>Physical Properties</td>
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<td>-----------------------------------</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>TLV 5 ppm PEL 1 ppm STEL 5 ppm</td>
<td>Ca</td>
<td>I</td>
<td>Weakness; abdominal pain</td>
<td>FP = -108°F LEL = 3.6% UEL = 33% State = gas VP = 2,600 mm at 77°F VD = 2.15</td>
<td>Copper, oxidizing material</td>
<td>IP = 9.99 eV HNu = 50%</td>
</tr>
<tr>
<td>Xylenes</td>
<td>TLV 100 ppm PEL 100 ppm</td>
<td>1,000 ppm</td>
<td>I</td>
<td>Dizziness; excitement; drowsiness; irritated eyes, nose, throat; nausea, vomiting; abdominal pain</td>
<td>FP = 90°/84°/81°F LEL = 1/1.1/1.1% UEL = 6/7/7% State = liquid VP = 10 mm at 81°F VD = 3.66</td>
<td>Strong oxidizers</td>
<td>IP = 8.56/8.56/8.44 eV OVA = 111 to 116%</td>
</tr>
<tr>
<td>SVOCs</td>
<td>TLV 5 mg/m^3 PEL 5 mg/m^3</td>
<td>Not available</td>
<td>G</td>
<td>Strong irritant to eyes and mucous membranes; narcotic</td>
<td>FP = 325°F LEL = Unk UEL = Unk State = liquid</td>
<td>Combustible; when heated to decomposition produces acid smoke</td>
<td>NA</td>
</tr>
<tr>
<td>Diethyl phthalate</td>
<td>TLV and PEL 5 ppm</td>
<td>250 ppm</td>
<td>I</td>
<td>Irritated eyes, nose, throat; weakness, muscle ache; pain</td>
<td>FP = 174°F LEL = 1.7% UEL = 8.6% State = solid/liquid</td>
<td>Strong oxidizers; calcium hypochlorite</td>
<td>IP = 8.5 eV</td>
</tr>
<tr>
<td>Phenol (2,4-Dimethylphenol, 2-Nitrophonol similis)</td>
<td>TLV and PEL 5 ppm</td>
<td>250 ppm</td>
<td>I</td>
<td>Irritated eyes, nose, throat; weakness, muscle ache; pain</td>
<td>FP = 174°F LEL = 1.7% UEL = 8.6% State = solid/liquid</td>
<td>Strong oxidizers; calcium hypochlorite</td>
<td>IP = 8.5 eV</td>
</tr>
<tr>
<td>Indicator Parameters</td>
<td>NA</td>
<td>Ca</td>
<td>I</td>
<td>Nitrate -- dizziness, abdominal cramps, vomiting, bloody diarrhea, weakness, convulsions, and collapse; small doses may lead to weakness, general depression, headache, and mental impairment</td>
<td>FP = NA LEL = NA UEL = NA</td>
<td>Nitrate -- powerful oxidizing agent; moderate fire hazard; explosive when shocked</td>
<td>NA</td>
</tr>
<tr>
<td>Nitrate</td>
<td>NA</td>
<td>Ca</td>
<td>G</td>
<td>Nitrite -- Large amounts produce nausea, vomiting, cyanosis, collapse, and coma; repeated small doses cause fall in blood pressure, rapid pulse, headache, and visual disturbances</td>
<td>FP = NA LEL = NA UEL = NA</td>
<td>Nitrite -- generally powerful oxidizer; shock may explode; reacts with reducing materials</td>
<td>NA</td>
</tr>
</tbody>
</table>

* Standards/Criteria: TLV = Threshold Limit Value, PEL = Permissible Exposure Limit, STEL = Short-Term Exposure Limit

** Relevant Instrumental Information: IP = Ionizing Potential, HNu = Heat of Neutralization, OVA = Oxidation-Valence-Angle, NA = Not Applicable
Table 4-1, Continued

<table>
<thead>
<tr>
<th>Chemical of Potential Concern</th>
<th>Standards/Criteria*</th>
<th>IDLH</th>
<th>Exposure Route</th>
<th>Symptoms of Acute Exposure</th>
<th>Physical Properties</th>
<th>Reactivity/Incompatible With</th>
<th>Relevant Instrumental Information**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td>TLV 0.2 Fiber/cc</td>
<td>Ca</td>
<td>1</td>
<td>Dyspnea, interstitial fibrosis, restricted pulmonary function, finger clubbing</td>
<td>FP = NA LEL = NA UEL = NA</td>
<td>None</td>
<td>NA</td>
</tr>
</tbody>
</table>

TLV = Threshold limit value  
PEL = Permissible exposure limit  
TWA = Time-weighted average  
IDLH = Immediately dangerous to life and health  
GW = Groundwater  
SW = Surface water  
Sed = Sediment  
I = Inhalation  
G = Ingestion  
C = Contact  
S = Skin absorption  
STEL = Short term exposure limits  
* OSHA PELs are standards; ACGIH TLVs are criteria.

FP = Flash point  
LEL = Lower exposure limit  
UEL = Upper explosive limit  
VP = Vapor pressure  
VD = Vapor density  
IP = Ionization potential  
HNU = PI-101 photonization detector equipped with 11.7 eV probe  
OVA = Organic vapor analyzer  
Ca = Carcinogen  
J = Present below quantification limit  
NA = Not applicable  
Unk = Unknown  
** HNU and OVA response factors reported as percentages of total compound concentration that can be detected by instrument.
4.2 PHYSICAL HAZARDS AND PROTECTIVE MEASURES

Physical hazards that may be encountered during RI/FS activities at Laurel Landfill include:

- Heat stress
- Cold stress
- Rain, snow, ice
- Lightning
- Underground and overhead utilities
- Excavating
- Hand and power tools
- Noise
- Hot work
- Drill rig operations
- Machinery and mechanical operations
- Steam cleaning
- Heavy lifting/moving
- Hazardous materials use and storage
- Fire

The following is a detailed discussion of each physical hazard and designated protective measures. See Table 4-2 for a task-by-task risk analysis for physical and biological hazards.

4.2.1 Heat Stress

Heat stress may result from wearing protective clothing that increases body temperature and decreases natural body ventilation, although it may occur at any time work is being performed at elevated temperatures.

If the body’s physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physiological reactions can occur, ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal.
### Table 4-2

#### Physical Hazards of Concern

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Task No.(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat stress</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>Cold stress</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>Rain, snow, ice</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>Lightning</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>Underground and overhead utilities</td>
<td>2, 5</td>
</tr>
<tr>
<td>Excavating</td>
<td>5</td>
</tr>
<tr>
<td>Hand and power tools</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>Noise</td>
<td>2, 3</td>
</tr>
<tr>
<td>Hot work</td>
<td>2</td>
</tr>
<tr>
<td>Drill rig operations</td>
<td>2</td>
</tr>
<tr>
<td>Machinery and mechanical operations</td>
<td>2, 3, 5</td>
</tr>
<tr>
<td>Steam cleaning</td>
<td>2</td>
</tr>
<tr>
<td>Heavy lifting/moving</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>Hazardous material use and storage</td>
<td>2, 3, 4, 5</td>
</tr>
<tr>
<td>Fire</td>
<td>2, 3, 4, 5</td>
</tr>
</tbody>
</table>

1. **Surveying**
   - Site survey, topo map
   - Site recon, well survey
   - Settlement points - installation, biweekly survey

2. **Drilling**
   - Monitor well installation
   - Solid waste thickness eval. borings

3. **Groundwater Sampling**
   - Monitor well sampling
   - Residential well sampling
   - Aquifer testing
   - Monthly water level measurements
   - Irrigation well monitoring

4. **Soil and Surface Water Sampling**

5. **Air Investigation**
   - Site screening
   - Air sampling

6. **Biota/Wetland Investigation**
   - Transect/plot establishment
   - Flora sampling
   - Fauna Sampling
   - Wetlands delineation
<table>
<thead>
<tr>
<th>Hazard</th>
<th>Task No.(^{(1)})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biological Hazards of Concern</strong></td>
<td></td>
</tr>
<tr>
<td>Poisonous plants</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>Insects</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>Snakes</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
</tbody>
</table>

1. **Surveying**
   a. Site survey, topo map
   b. Site recon, well survey
   c. Settlement points - installation, biweekly survey

2. **Drilling**
   a. Monitor well installation
   b. Solid waste thickness eval. borings

3. **Groundwater Sampling**
   a. Monitor well sampling
   b. Residential well sampling
   c. Aquifer testing
   d. Monthly water level measurements
   e. Irrigation well monitoring

4. **Soil and Surface Water Sampling**

5. **Air Investigation**
   a. Site screening
   b. Air sampling

6. **Biota/Wetland Investigation**
   a. Transect/plot establishment
   b. Flora sampling
   c. Fauna Sampling
   d. Wetlands delineation
Because heat stress is one of the most common and potentially serious acute illnesses at hazardous waste sites, regular monitoring and other preventative measures are vital. Workers must learn to recognize and treat the various forms of heat stress. The best approach is preventive heat stress management. In general:

- Encourage workers to drink water before beginning work, such as in the morning or after lunch, and throughout the day. Provide disposable 4-ounce cups and water that is maintained at 50° to 60°F. Ensure workers understand that the normal thirst mechanism is not sensitive enough to provide adequate fluids to replace sweat loss. Provide a cool area for rest breaks. Discourage the intake of caffeinated beverages during working hours. Monitor for signs of heat stress.

- Acclimatize workers to work area conditions by slowly increasing workloads, i.e., do not begin work with extremely demanding activities.

- Provide cooling devices to aid natural body ventilation. These devices, however, add weight, and their use should be balanced against worker efficiency. An example of a cooling aid is long cotton underwear that acts as a wick to absorb moisture and protect the skin from direct contact with nonabsorbent protective clothing.

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

- Provide adequate shelter to protect personnel against heat as well as cold, rain, snow, etc. If possible, set up shelter in a shaded area.

- In hot weather, rotate shifts of workers or use administrative work/rest controls.

- Good hygienic standards must be maintained by frequent changes of clothing and showering. Persons who notice skin problems should notify SHSC and then seek medical consultation.

4.2.1.1 Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress, caused by a failure of heat-regulating mechanisms of the body; the individual's temperature control system that causes
sweating stops working correctly. Body temperature rises so high that brain damage and death can result if the person is not cooled quickly.

- **Symptoms** -- Red, hot, dry skin, although the person may have been sweating earlier; nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rates; unconsciousness or coma.

- **Treatment** -- Obtain medical help immediately. Cool the victim quickly. Soak the victim (if possible) in cool, but not cold, water; sponge the body with cool water; pour water on the body to reduce the temperature; and fan the person. Observe the victim. Do not administer fluids.

4.2.1.2 Heat Exhaustion

Heat exhaustion is a state of extreme weakness caused by the loss of body fluids. The condition is much less dangerous than heat stroke, but it must be treated nonetheless.

- **Symptoms** -- Pale, clammy, moist skin; profuse perspiration and extreme weakness. Body temperature is normal, pulse is weak and rapid, breathing is shallow. The person may have a headache, may vomit, and may be dizzy.

- **Treatment** -- Remove the person to a cool place, loosen clothing, place in a head-low position, and provide rest. Consult a physician, especially in severe cases. The normal thirst mechanism is not sensitive enough to ensure body fluid replacement. Have the patient drink 1 to 2 cups of water and electrolyte solution immediately and every 20 minutes thereafter until symptoms subside. A person that is nauseated or unconscious should not be given water.

4.2.1.3 Heat Cramps

Heat cramps are caused by perspiration that is not balanced by adequate electrolyte intake. Heat cramps are often the first sign of a condition that can lead to heat exhaustion.
• **Symptoms** -- Acute painful spasms of muscles, e.g., abdomen and extremities.

• **Treatment** -- Remove victim to a cool area, and loosen clothing. Have the patient drink water immediately and rest until symptoms subside.

### 4.2.1.4 Heat Rash

Heat rash is caused by continuous exposure to heat, humid air, and chafing clothes. The condition decreases the ability to tolerate heat.

• **Symptoms** -- Mild red rash, especially in areas of the body that come in contact with protective gear.

• **Treatment** -- Decrease the amount of time in protective gear, and provide powder to help absorb moisture and decrease chafing.

### 4.2.1.5 Heat Stress Monitoring and Work Cycle Management

For field activities that are part of ongoing work activities during hot weather (> 70°F), a review of the symptoms of heat stress, heat stroke, heat exhaustion, heat cramps, and heat rash will be given daily to field personnel.

• Fluids (i.e., water) will be made available at each work location.

• Routine rest periods will be encouraged. Field personnel will be reminded to examine their own physiological conditions throughout the day.
Certain activities are inherently strenuous (e.g., performing work in level B or C protection when temperatures exceed 70°F, shoveling, carrying heavy objects). During these activities the SHSC should determine when the following procedures should be implemented:

- **Measure Heart Rate** -- Heart rate (HR) should be measured by the radial pulse for 30 seconds as early as possible during the resting period. The HR at the beginning of the rest period should not exceed 110 beats per minute (bpm). If the HR is higher, the next work period should be shortened by 33%, while the length of the rest period stays the same. If the pulse rate still exceeds 110 bpm at the beginning of the next rest period, the following work cycle should be further shortened by 33%. The procedure is continued until the rate is maintained below 110 bpm.

- **Measure Body Temperature** -- Body temperature should be measured with a clinical thermometer as early as possible during the resting period.

If the oral temperature (OT) exceeds 99.6°F at the beginning of the rest period, the next work cycle should be shortened by 33%, while the length of the rest period stays the same. If the OT exceeds 99.6°F at the beginning of the next rest period, the following work cycle should be further shortened by 33%. The procedure is continued until the body temperature is maintained below 99.6°F.

- **Physiological Monitoring Schedule** -- The following suggested frequency of physiological monitoring schedule for fit and acclimated workers will be used as a guideline.
Adjusted Temperature* | Level D | Levels C and B
---|---|---
≥90°F (≥32.2°C) or above | After each 45 minutes of work | After each 15 minutes of work
87.5° to <90°F (30.8°-<32.2°C) | After each 60 minutes of work | After each 30 minutes of work
82.5° to <87.5°F (28.1°-<30.8°C) | After each 90 minutes of work | After each 60 minutes of work
77.5° to <82.5°F (25.3°-<28.1°C) | After each 120 minutes of work | After each 90 minutes of work
72.5° to <77.5°F (22.5°-<25.3°C) | After each 150 minutes of work | After each 120 minutes of work

*Measure the air temperature with a standard thermometer. Estimate the fraction of sunshine by judging what percent the sun is out.

100% sunshine = no cloud cover = 1.0 sunshine factor
50% sunshine = 50% cloud cover = 0.5 sunshine factor
0% sunshine = full cloud cover = 0.0 sunshine factor

Adjusted temperature = actual temperature + (13 x sunshine factor).

The length of work period is governed by the frequency of the physiological monitoring schedule. The length of the rest period is governed by physiological parameters (heart rate and oral temperature). For example, if an individual's heart rate exceeds 110 bpm at the beginning of the rest period, that individual will remain on rest time until his/her heart rate drops well below 110 bpm, and the next work period (duration of time before suggested physiological monitoring) will be decreased by 33%. Workers' physical symptoms or condition will also be an indicator to modify the work schedule.
4.2.2 Cold Stress

Persons working outdoors in low temperatures, especially at or below freezing, are subject to cold stress. Exposure to extreme cold for a short time can cause severe injury to exposed body surfaces or result in profound generalized cooling. Areas of the body that have high surface area to volume ratios, such as fingers, toes, and ears, are the most susceptible. Protective clothing does not provide protection against cold. In many instances, it increases susceptibility. Chemical hazard workers must learn to dress carefully to provide protection against low temperatures while not dressing so warmly that exercise or strenuous activity will result in heat stress.

Two factors that influence the potential of cold injury are: ambient temperature and wind velocity. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. Additionally, water conducts heat 240 times faster than air; thus, the body cools suddenly when protective equipment is removed if the clothing underneath is perspiration soaked.

Tables 4-3 and 4-4 should be consulted to adjust working schedules for wind chill conditions. These tables are meant as guidelines only; ambient temperatures and wind conditions should be monitored frequently and work schedules adjusted as required. Workers’ physical symptoms or condition will also be an indicator to modify work schedule.

The following guidelines should be used when working in air temperatures below 40°F:

- When cold surfaces below -7°C (19.4°F) are within reach, a warning should be given to each worker by the SHSC to prevent inadvertent contact by bare skin.
Table 4-3

Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature*

<table>
<thead>
<tr>
<th>Estimated Wind Speed (mph)</th>
<th>Actual Temperature Reading (°F)</th>
<th>Equivalent Chill Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>calm</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>48</td>
<td>37</td>
</tr>
<tr>
<td>10</td>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td>20</td>
<td>32</td>
<td>18</td>
</tr>
<tr>
<td>25</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>35</td>
<td>27</td>
<td>11</td>
</tr>
</tbody>
</table>

(Wind speeds greater than 40 mph have little additional effect.)

<table>
<thead>
<tr>
<th>LITTLE DANGER</th>
<th>INCREASING DANGER</th>
<th>GREAT DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>In &lt;1 hour with dry skin.</td>
<td>Danger from freezing of exposed flesh within 1 minute.</td>
<td>Flesh may freeze within 30 seconds.</td>
</tr>
</tbody>
</table>

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.
Table 4-4

Cold Work/Warmup Schedule for 4-Hour Shifts

<table>
<thead>
<tr>
<th>Equivalent Chill Temperature</th>
<th>Maximum Work Period</th>
<th>Number of Breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥-24°F</td>
<td>Normal</td>
<td>1</td>
</tr>
<tr>
<td>-25° to -30°F</td>
<td>75 minutes</td>
<td>2</td>
</tr>
<tr>
<td>-31° to -35°F</td>
<td>55 minutes</td>
<td>3</td>
</tr>
<tr>
<td>-36° to -40°F</td>
<td>40 minutes</td>
<td>4</td>
</tr>
<tr>
<td>-41° to -45°F</td>
<td>30 minutes</td>
<td>5</td>
</tr>
<tr>
<td>≤-46°F</td>
<td>Stop work</td>
<td>Stop work</td>
</tr>
</tbody>
</table>
If the air temperature is -17.8°C (0°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (39.2°F). The workers should wear cold-protective clothing appropriate for the level of cold and physical activity:

- If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.

- If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments should include provisions for easy ventilation to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the employee should make sure that clothing is not wet as a consequence of sweating. If clothing is wet, the employee should change into dry clothes before entering the cold. The workers should change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change should be determined empirically and will vary individually and according to the type of shoe worn and how much the individual’s feet sweat.

- If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

- Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 4°C (39.2°F) should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling.

If work is performed continuously in the cold at an equivalent chill temperature (ECT) below -7°C (19.4°F), heated warming shelters, tents, cabins, rest rooms, cars/trucks, etc., should be made
available nearby. The workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing should be provided as necessary to prevent workers from returning to work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of caffeine should be limited because of the diuretic and circulatory effects. Consumption of these liquids will take place outside the exclusion zone, in the support zone, as defined in Subsection 5.4.

The following should apply for work practices at or below -12°C (10.4°F) ECT:

- The worker should be under constant protective observation (buddy system or supervision).
- The work rate should not be so great as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters, and an opportunity to change into dry clothing should be provided.
- New employees should not be required to work full time in the cold during the first days of employment until they become acclimated to the working conditions and required protective clothing.
- The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
The work should be arranged in such a way that sitting still or standing still for long periods is minimized. The worker should be protected from drafts to the greatest extent possible.

The workers should be instructed in health and safety procedures. The training program should include, as a minimum, instruction in:

- Proper rewarming procedures and appropriate first aid treatment.
- Proper clothing practices.
- Proper eating and drinking habits.
- Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
- Safe work practices.
- Primary warming structures include the on-site office trailer.

4.2.2.1 Frostbite

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

- Frostnip or incipient frostbite, characterized by sudden blanching or whitening of skin.
- Superficial frostbite, characterized by skin with a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- Deep frostbite, characterized by tissue that is cold, pale, and solid.

First aid for frostbite consists of taking the victim indoors, and rewarming the areas quickly in water that is between 39° and 41°C (102° to 105°F). Give a warm drink -- water or juices; not coffee, tea, or alcohol. The victim must not smoke. Keep the frozen parts in warm water or
covered with warm clothes for 30 minutes, even though the tissue will be very painful as it thaws. Elevate the injured area, and protect it from injury. Do not allow blisters to be broken. Use sterile, soft, dry material to cover the injured areas. Keep the victim warm, and get immediate medical care.

After thawing, the victim should try to move the injured areas a little, but no more than can be done alone, without help. Seek medical attention as soon as possible.

Note:

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

4.2.2.2 Hypothermia

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperatures. Its symptoms are usually exhibited in four stages:

- Shivering.
- Numbness.
- Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F.
- Unconsciousness, glassy stare, slow pulse, and slow respiratory rate.
- Death.
If hypothermia is suspected in any field personnel, remove the person to a warmer location until symptoms recede. First aid for hypothermia consists of the following:

- Give artificial respiration, if necessary.
- Bring the victim into a warm room as quickly as possible.
- Remove wet or frozen clothing and anything that is constricting.
- Rewarm the victim rapidly by wrapping him in warm blankets, or by placing him in a tub of water that is warm but not hot to the hand or forearm.
- If the victim is conscious, give him hot liquids by mouth (not alcohol).
- Dry the victim thoroughly if water was used to rewarm him.
- Carry out appropriate procedures as described for frostbite.
- Seek medical attention as soon as possible.

4.2.3 Rain, Snow, and Ice

Rain, snow, or ice conditions may cause slippery conditions, impair vision, create hidden hazards, and increase the risk of electrical shock. Individuals working during any of these three conditions may encounter the following:

- Vehicle operation may be hampered by window fogging/frosting or slippery driving conditions.
- These conditions will increase the chance of slipping when walking, climbing steps and ladders, and working at elevation.
- Heavy snow or ice may cause electric lines to sag or break.
- Use of electric equipment in these conditions will increase the risk of electrical shock.
• Snow may cover holes, mud, water, drums, or sharp objects, which may hamper vehicle operation or create falling or puncture hazards.

• Fog may hamper vehicle operation or visual communication among workers.

• These conditions may cause slippage of braking devices on augers, drills, etc.

• Wet conditions in soil during trenching and excavating activities may weaken side walls and increase the risk of cave-in.

To ensure safe working conditions during rain, snow, and icy weather the SHSC should be aware of changing weather conditions and instruct workers to stop work or proceed cautiously when these conditions are encountered.

4.2.4 **Lightning**

Lightning represents a hazard of electrical shock that may result in death. The following procedures will be observed to protect workers from lightning strikes:

• Monitor weather reports.

• Note weather changes and conditions that produce lightning. These include dark clouds and the sound of thunder.

• Stop work in open areas, around drill rigs, other structures that may attract lightning, on or in water, and in elevated work places when lightning strikes are sighted or thunder is heard.
4.2.5 Underground and Overhead Utilities

The presence of underground and overhead utilities will be determined before work begins. Guidelines to observe when working in areas with underground and overhead utilities are as follows:

- The location of any utility that could pose a risk to workers will be communicated to all workers during the safety briefing. Utilities will be marked or access otherwise restricted to avoid chance of accidental contact.
- Even when a search is completed, drilling, boring, and excavation should commence carefully until past the depth at which such utilities are usually located.
- Overhead transmission and distribution lines will be carried on towers and poles that provide safe clearance over roadways and structures.
- Clearances will be adequate for the movement of vehicles and for the operation of construction equipment.
- Overhead or aboveground electric lines will be considered "live" or active until a reliable source has documented them to be otherwise.
- Elevated work platforms, ladders, scaffolding, man-lifts, and drill or vehicle superstructures will be erected a minimum of 20 feet (the actual distance is dependent upon the voltage of the line) from overhead electrical lines until the line is de-energized, grounded, or shielded and a competent electrician has certified that arcing cannot occur between the work place and superstructure.
- Workers will be instructed to use care in working under or around utilities to avoid hot surfaces, loud noises, pressured gases or air, leaking of pipelines, and discharge of steam or hot liquids.

4.2.6 Hand and Power Tools and Accessories

When using hand and power tools and their accessories, safety checks and procedures should be observed.
4.2.6.1 Safety Checks

The following safety checks should be conducted prior to using tools or their accessories:

- Tools having defects that will impair their strength or render them unsafe will be tagged or made inoperable and removed from service.

- Safety guards must be in place during the operation of all power tools designed to accommodate them. Guards and safety devices must remain in place on power tools unless removed according to manufacturer's instructions for maintenance by a competent person and must be replaced before use. Belts, gears, shafts, drums, flywheels, chains, or other rotating, reciprocating, or moving parts exposed to employee contact or representing a hazard must be guarded.

- Only nonsparking tools will be used in locations where sources of ignition may cause a fire or explosion.

- Power tools will be inspected, tested, and determined to be safe for operation prior to each use. Continued periodic inspections will be made to ensure safe operating condition and proper maintenance.

- Electric-powered tools must be approved, double insulated, or grounded in accordance with 29 CFR Part 1926 Subpart K.

- Rotating or reciprocating portable power tools will have a constant pressure switch that will shut off the power when the tool is released by the operator. A portable power tool may have a lock-on control, provided turn-off can be accomplished by a single motion of the same finger or fingers that turned it on.

- Hydraulic fluid used in powered tools will retain its operating characteristics at the most extreme temperatures to which it will be exposed.

- All hydraulic or pneumatic tools used on or around energized lines or equipment will have nonconducting hoses having adequate strength for the normal operating pressures.

- Extension cords should meet Underwriters' Laboratory (UL) or other rating criteria according to OSHA.

- Extension cords should be tested for continuity before each use and must be connected to ground fault current interrupters.
Extension cords should be inspected daily for loose insulation, broken or missing plugs, bared wires, etc. Damaged extension cords will be removed from service.

4.2.6.2 Operating Procedures

The following guidelines should be observed when operating hand and power tools and their accessories:

- Loose and frayed clothing, loose long hair, dangling jewelry, rings, chains, and wristwatches will not be worn while working with any power tools or machines.
- Manufacturers' safe operating pressures for hydraulic hoses, valves, pipes, filters, and other fittings will not be exceeded.
- Proper personnel protective equipment must be used when operating power tools or hand tools that may produce projectiles, cuts or abrasions, dust, fumes, mists, or light, or which pose a risk of harm to arms, legs, or feet if dropped.
- Throwing tools or materials from one location to another, from one person to another, or dropping them to lower levels is not permitted.
- Extension cords should not be allowed to become tripping or slipping hazards.
- Extension cords should not be used for lifting or tying off and will be disconnected by pulling on the plug.

4.2.7 Noise

Noise usually is sound that bears no information and whose intensity usually varies randomly in time. It interferes with the perception of wanted sound and can be physiologically harmful. Exposure to intense noise causes hearing loss that may be temporary, permanent, or a combination of the two. Hearing impairment is insidious over a long period of time and is
reflected by elevated thresholds at which sound can be distinguished. A general rule to apply is that if noise prevents normal conversation at arms-length distance, the sound level is high enough to warrant hearing protection. Specific sources of hazardous noise anticipated at Laurel Landfill include but are not limited to the following:

- Compressor motors.
- Drill rig engines.
- Hammer blows for split-spoon samples.
- Compressed air.
- Compressed water.
- Heavy equipment.

Personnel must wear hearing protectors when in the vicinity of these operations or in the presence of any operation where noise prevents normal conversation at arms-length distance. Hearing protectors can be either ear plugs or ear muffs. All personnel will be instructed in the proper use of hearing protection.

4.2.8 Drill Rig Operation

Drill rigs should be operated by individuals holding a current driller’s license for the State of Delaware.

WESTON employees observing drilling activities will be aware of the physical hazards associated with drilling and the safe operating procedures they should use.
4.2.8.1 Drilling Hazards

Hazards associated with drilling activities include:

- Leaking or bursting hydraulic hoses.
- Broken cables.
- Heavy weights.
- Weather (i.e., rain, snow, ice, lightning).
- Limited access/congested areas.
- Noise that limits verbal communication.

4.2.8.2 Safe Drill Rig Operating Procedures

WESTON employees observing drill rig activities will use the Drilling Safety Guide in Appendix C and follow these general safe operating procedures:

- At a minimum, individuals should wear coveralls, steel-toe boots, and hard hats.
- Hearing protection should be used when conditions prevent normal vocal discussion between two individuals at arms-length distance.
- Individuals observing drill rig activities should maintain visual contact with the drillers.
- Individuals should not enter the drilling area unless given approval by the drillers. This will ensure that the drillers will be aware of your movements.
- Drilling activities must cease when weather conditions indicate lightning strikes are possible.
4.2.9 Machinery and Mechanical Equipment

Preinspections will be conducted and safe operational maintenance procedures followed when using machinery or mechanical equipment. The following are guidelines detailing ways to ensure the safe operation of equipment.

4.2.9.1 Renting or Operating Equipment

The following checks will be conducted before equipment is rented or operated:

- Lift trucks, stackers, etc., will have the rated capacity posted on the vehicle so as to be clearly visible to the operator. When auxiliary removable counterweights are provided by the manufacturer, corresponding alternate rated capacities also will be clearly shown on the vehicle. The ratings will not be exceeded.

- Steering or spinner knobs will not be attached to the steering wheel unless the steering mechanism prevents road reactions from causing the steering handwheel to spin. When permitted, the steering knob will be mounted within the periphery of the wheel.

- All industrial trucks in use will meet the requirements of design, construction, stability, inspection, testing, maintenance, and operation defined in ANSI B56.1, Safety Standards for Powered Industrial Trucks.

- All equipment with windshields will be equipped with powered wipers. Vehicles that operate under conditions that cause fogging or frosting of windshields will be equipped with operable defogging or defrosting devices.

- All towing devices used on any combination of equipment will be structurally adequate for the weight drawn and securely mounted.

- Inspections or determinations of road conditions and structures will be made in advance to ensure that clearness and load capacities are safe for the passing or placing of any machinery or equipment.
All equipment left unattended at night, adjacent to a highway in normal use, or adjacent to construction areas where work is in progress will have lights or reflectors, or barricades equipped with lights or reflectors, to identify the location of the equipment.

Cranes and any other equipment used for lifting must be inspected as required, and records of inspection must be maintained.

Before any machinery or mechanized equipment is placed in use, it will be inspected and tested by a competent mechanic and certified to be in safe operating condition.

The employer will designate a competent person (i.e., an individual knowledgeable in the safe operation and maintenance of the equipment) to be responsible for the inspection of all machinery and equipment daily and during use to make sure it is in safe operating condition. Tests will be made at the beginning of each shift during which the equipment is to be used to determine whether the brakes and operating systems are in proper working condition.

Preventive maintenance procedures recommended by the manufacturer will be followed.

Any machinery or equipment found to be unsafe will be deadlined and its use prohibited until unsafe conditions have been corrected.

4.2.9.2 Equipment Operation

The following safety rules will be observed when operating equipment:

- Stationary machinery and equipment will be placed on a firm foundation and secured before being operated.
- Machinery and mechanical equipment will be placed on a firm foundation and secured before being operated.
- Seats or equal protection will be provided for each person required to ride on equipment.
- Getting off or on any equipment while it is in motion is prohibited.
• Machinery or equipment requiring an operator will not be permitted to run unattended.

• Machinery or equipment will not be operated in a manner that will endanger persons or property, nor will safe operating speeds or loads be exceeded.

• Persons will not be permitted to get between towed and towing equipment until the towing equipment has stopped.

• The installation of live booms on material and personnel hoists is prohibited.

• The controls of loaders, excavators, or similar equipment with folding booms or lift arms will not be operated from a ground position unless so designed.

• Personnel will not work under or pass under the buckets or booms of loaders in operation.

• When necessary, all mobile equipment and the operating area will be adequately illuminated while work is in progress.

• Mechanical equipment will be shut down prior to and during fueling operations. Closed systems, with automatic shutoff that will prevent spillage if connections are broken, may be used to fuel diesel-powered equipment left running.

• Whenever the equipment is parked, the parking brake will be set. Equipment parked on inclines will have the wheels chocked or track mechanism blocked and the parking brake set.

4.2.9.3 Equipment Maintenance

The following safety rules will be observed when maintaining equipment:

• All points requiring lubrication during operation will have fittings so located or guarded to be accessible without hazardous exposure.

• All machinery or equipment will be shut down and positive means taken to prevent its operation while manual lubrication or repairs are being done. Exemption: Equipment designed to be serviced while running.

• All repairs on machinery, equipment, or parts thereof will be made at a location that will provide protection from traffic for repair persons.
Heavy machinery, equipment, or parts thereof that are suspended or held apart by slings, hoists, or jacks also will be substantially blocked or cribbed before personnel are permitted to work underneath or between them.

Bulldozer and scraper blades, end-loader buckets, dump bodies, and similar equipment will be either fully lowered or blocked when being repaired or when not in use. All controls will be in a neutral position, with the engines stopped and brakes set, unless work being performed on the machine requires otherwise.

4.2.10 Fire

The following fire safety rules will be posted in the site trailer and observed by all personnel on-site:

- Workers must know the location, use, and limitation of available fire extinguishers.
- Fire lanes to provide access to all areas must be maintained free of obstruction.
- Material storage must be arranged to minimize the spread of fire internally and to permit access for fire fighting.
- Clearance must be maintained around lights and heating units to prevent ignition of combustible materials.
- All sources of ignition must be prohibited in areas where flammable liquids are stored, handled, and processed. Suitable "NO SMOKING" signs will be posted in all such areas.
- Smoking will be prohibited in all areas where flammable, combustible, or similar hazardous materials are stored, except in those locations specifically provided for such purpose and approved by the SHSC.
- In the case of fire, refer to Emergency Response Procedures, Section 6.4.2. An additional copy of these Emergency Response Procedures will be kept at the on-site trailer.
4.2.11 Steam Cleaning/Pressure Washing

Steam represents severe thermal burn hazard. It may condense and leave wet work surfaces and will displace oxygen in enclosed areas. The heat and high humidity associated with steam also may affect instruments and the performance of personnel protective equipment.

Safety practices to be observed when operating a steam cleaner are as follows:

- Avoid contact with the surfaces of the equipment.
- Always work so steam spray is directed away from the body.
- Do not hold equipment being steamed.
- Wear appropriate personnel protective equipment (kept dry):
  - Long-sleeved and pant-legged clothing.
  - Leather work safety boots.
  - Heat insulating gloves.
  - Face shield (for steam cleaning).
  - Safety glasses or goggles (for pressure washing).
  - Latex boot covers.

Steam equipment users should note that personnel protective equipment will provide protection from incidental contact, but may not protect for prolonged periods.

High-pressure systems can also cause bruising if directed at the body and can project particles able to penetrate personnel protective equipment.
Steam equipment use will often increase the ambient air temperature and humidity, adding to risk of heat stress. The potential for elevated heat levels must be identified in preliminary safety surveys, and heat stress prevention measures must be instituted.

Heat, high humidity, and moisture will affect the function and reliability of many monitoring instruments. Instruments must be used according to manufacturer's directions and appropriate response factors or preconditions applied.

Heat, high humidity, and moisture will affect performance of respirators, particularly cartridges and canisters, and chemical protective clothing, making rubbery materials pliable and inelastic and penetrating seams of stitched overalls. Workers will be alerted to increased likelihood of respirator and protective clothing breakthrough. Inspection, doffing, and donning procedures will be modified to take these effects into account.

4.2.12 Heavy Lifting/Moving

Improper lifting can result in cuts, pinches, crushing, and serious back, abdomen, arm, and leg muscle and joint injury. Even "light" objects, lifted improperly, can contribute to injury, causing cuts and muscle injuries.

Mechanical equipment or assistance such as dollies, carts, come-alongs, or rollers are to be used whenever possible. Mechanical assistance must be of proper size, have wheels sized for the terrain, and be designed to prevent pinching or undue stress on wrists. Objects to be moved must be secured to prevent falling and properly balanced to prevent tipping.
The minimum protection for manual handling is heavy cotton or leather gloves, safety boots, and coveralls. Metatarsal guards, chemical-protective clothing, and metal mesh or Kevlar gloves must be used as the risk of heavy items falling, or contact with hazardous materials or sharp edges, splinters, or slivers increases.

Workers must be aware of their handling capacities and work within their capacities. When lifting an object from the floor:

- Determine that object is within safe weight limit.
- Check for contact hazards.
- Check floor for slip hazards.
- Check that there is ample space between the object to be lifted and other objects to avoid pinching or crushing.
- Check that there is ample room to squat, lift, turn, or maneuver without twisting the back or other muscles or joints.
- Walk the intended route of travel to identify and remove slip and fall hazards, if possible.
- Identify changes in elevation, steps, ramps, stairs, and ladders that must be negotiated.

To lift square or rectangular objects:
- Place one foot slightly in front of the other.
- Squat as close to the object as possible.
- Grasp one of the top corners away from the body and the opposite bottom corner closest to the body.
- Tilt the object slightly away from the body, tilt forward at the hips, keep the back straight, and tuck in the chin.
Test to be sure the object is loose from floor and will lift without snagging.

- Straighten the legs, keeping the backbone straight, pull the object into the body, and stand up slowly and evenly without jerking or twisting.

- If turning or change of direction is required, turn with feet without twisting the torso and step in the direction to travel.

- To set an object down, reverse the sequence, being sure not to trap the bottom hand between the object and the surface on which the object is set.

This system at first feels and seems awkward. Workers should use the system with lighter objects before performing heavy lifting. For sharp objects, the only modification needed should be handhold position.

Do not carry objects in a manner that obstructs vision in line of travel and of feet and footing. Carry objects so one hand is free for travel on stairs and there is unobstructed view of footing. Heavy objects should not be handled while on a ladder, as two hands are required.

When two or more persons are lifting, have a plan and set signals so lifting occurs simultaneously. Flat, square, or rectangular objects are most easily handled using make-shift rollers or skids, or break the friction with the resting surface, and push using the legs.

**4.2.12.1 Moving Round or Cylindrical Objects**

These objects should be rolled if rolling will not damage the structural integrity. Rolling must be controlled by chute, tag-line, or other means of limiting acceleration.Workers must not be
positioned downhill from rolled objects. Use of the legs for pushing and tag-line control of rolled objects must be stressed.

Cylindrical objects, such as drums that must remain upright, are handled manually by slighting tilting the object, using the legs for control, and balancing the object on the bottom edge. The handler then walks beside the object, with the object tilted toward the body, positioning the hands on the top edge away from the body and moving so they do not cross, thus, maintaining the balance and a steady controlled forward motion. Motion must be controlled so that stopping walking and moving the hands will stop forward motion.

Prior to moving cylindrical objects in this way, the route of travel must be walked to identify any changes of elevation, potholes, or other obstruction that would cause the object to snag, tip, or get out of control.

4.2.13 Hazardous Materials Use and Storage

Hazardous materials used and stored during RI/FS activities will include flammable liquids, corrosives, and cylinders. Following are use and storage guidelines for these materials. Material Safety Data Sheets will be obtained for hazardous materials used on-site, and attached to HASP as needed. Proper care and precautions will be taken to avoid storage of incompatible materials.
4.2.13.1 Flammable Liquids

The following procedures should be initiated when handling or storing flammable liquids:

- Flammable liquids will be stored in approved containers in flammable storage cabinets or store rooms, or 25 feet from any other storage or office area or any ignition sources (i.e., sparks, flames, oxidizers, and corrosives).
- Approved grounding and bonding procedures will be used for transfer of flammable liquids from one container to another.
- Areas where flammable liquids are stored or flammable vapors may be released must be evaluated and classed by hazard class, group, and location according to the National Electric Code, and electrical equipment use must conform to these codes.
- All tanks, containers, and pumping equipment, portable or stationary, used for the storage or handling or flammable and combustible liquids will be listed by FM or UL.
- As a minimum, a 10B fire extinguisher appropriate for the type of fire that could occur must be within 50 feet of any accumulation of 5 gallons or more of flammable liquids or gases.

4.2.13.2 Corrosives

The following measures will be taken to prevent undue exposure to corrosive substances:

- Appropriate protective clothing will be worn when handling corrosive substances.
- When not in use, corrosive substances will be stored in a metal cabinet in a secured area.
4.2.13.3 Cylinders

- Cylinders must be stored upright and/or secured to prevent their falling over. The supplier of gas must be consulted prior to storing gas cylinders in other than an upright position.

4.3 BIOLOGICAL HAZARDS

The biological hazards that site personnel may encounter are animal bites, stings, or contact with irritant plants (see Table 4-2). These hazards are applicable to all activities and are not specifically noted in the task-specific hazard analysis (listed in Table 5-1).

Animal bites or stings are usually nuisances (localized swelling, itching, and minor pain), which can be handled by first-aid treatments. The bites of certain snakes, lizards, spiders, and scorpions contain sufficient poison to warrant medical attention. There are diseases that can be transmitted by insect and animal bites. Examples are Rocky Mountain spotted fever, Lyme disease (tick), rabies (mainly dogs, skunks, and foxes), malaria, and equine encephalitis (mosquitos). The greatest hazard and most common cause of fatalities from animal bites, particularly bees, wasps, and spiders, is from a sensitivity reaction. Shocks due to stings can lead to severe reactions in the circulatory, respiratory, and central nervous systems, which also can result in death.

None of the personnel expected to be working on this task are known to be allergic to bee (etc.) stings. If anyone is assigned subsequently who is allergic, they will be required to have their prescribed treatment with them and first aid persons will know where it is located. All stings or bites will be taken seriously. Anyone stung or bitten will be required to stop work while that...
person is observed for signs of severe swelling, shortness of breath, nausea, or shock. If there is any doubt, medical attention will be obtained as per Section 6. The incidence of Lyme disease is rising in northeastern United States.

The PPE required during Exclusion Zone work will reduce the likelihood of exposure to fleas and ticks. However, workers are to observe the following precautions:

- Apply insect repellents to boots and other garments, particularly pant legs, during spring and summer seasons.
- Perform self examinations for ticks every four hours while on site during spring and summer seasons.

There has been a high incident rate of bites by wild rabid animals in the Laurel area over the past several years. All wild animals are to be avoided, especially wild animals that are overly passive or aggressive. Report such animals to appropriate authorities (e.g., SPCA).

The most dangerous toxic effects from plants are due to the ingestion of nuts, fruits, or leaves. Consequently, personnel are prohibited from eating any fruits, nuts, or other plant material that may grow on the site. Of more concern to response personnel are certain plants including poison ivy, poison oak, and poison sumac, which produce adverse effects from direct contact. The usual effect is dermatitis (inflammation of the skin). The protective clothing and decontamination procedures used for chemicals also reduce the exposure risk from plant toxins. Cleaning the skin thoroughly with soap and water after contact will reduce risk.
SECTION 5

PERSONNEL PROTECTION

This section outlines the specific procedures that will be used to prevent exposures or injuries during field work. Included in this section are prescribed levels of protection, action levels, monitoring schemes, decontamination procedures, and heat/cold stress prevention.

Table 5-1 provides an overview of the protection program planned for the Laurel Landfill site. This table lists activities to be conducted, primary level of protection, and monitoring requirements. The primary level of protection is defined as that level at which work commences. Downgrades and upgrades will be based upon established action levels (see Subsections 5.2 and 5.3), prevailing site conditions, and the SHSC's evaluation. The FSO and SHSC may implement upgrades, however, WESTON's Corporate Health and Safety must approve downgrades.

5.1 LEVELS OF PROTECTION

The primary level of protection to be used at Laurel landfill is D. Upgraded level D will be used for specific tasks where no respiratory protection is necessary but skin contact with contaminants should be prevented. Levels of protection as prescribed in this document may be modified by the SHSC according to specific field conditions.
### Table 5-1

**Summary of Personnel Protection Measures by Activity,**
**Sussex County Landfill No. 5 RI/FS,**
**Laurel, DE**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Primary Level of Protection</th>
<th>Monitoring Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-site survey</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Site reconnaissance/well inventory</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Settlement points — installation</td>
<td>D</td>
<td>HNu/11.7 or OVA, CGI/O₂, Draeger tubes and engineering controls</td>
</tr>
<tr>
<td>Settlement points — biweekly survey</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Monitor well installation</td>
<td>D</td>
<td>HNu/11.7 or OVA, CGI/O₂, Draeger tubes (vinyl chloride and benzene)</td>
</tr>
<tr>
<td>Solid waste thickness evaluation borings</td>
<td>C</td>
<td>HNu/11.7 or OVA, CGI/O₂, Draeger tubes (vinyl chloride and benzene)</td>
</tr>
<tr>
<td>Monitor well sampling</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Residential well sampling</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Aquifer testing</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Monthly water level measurements</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Irrigation well monitoring</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Soil sampling</td>
<td>C</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Surface water sampling</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
</tbody>
</table>

**D** = Upgrade to level C if HNu or OVA readings are greater than 5 units above background in the breathing zone or if dust is being created. Continue monitoring with HNu, OVA, and Draeger tubes. If Draeger tubes indicate benzene or vinyl chloride greater than 1 unit, or if the OVA reads greater than 50 units above background, upgrade to level B.

**C** = Monitor atmosphere with HNu and OVA. Upgrade to level B if instrument response is greater than 50 units above background in the breathing zone or upon notification by Corporate Health and Safety and the SHSC.
### Table 5-1
(continued)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Primary Level of Protection</th>
<th>Monitoring Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air investigation — site screening</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Air sampling</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Flora sampling</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Fauna sampling</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
<tr>
<td>Wetlands delineation</td>
<td>D</td>
<td>HNu/11.7 or OVA</td>
</tr>
</tbody>
</table>

**D** = Upgrade to level C if HNu or OVA readings are greater than 5 units above background in the breathing zone or if dust is being created. Continue monitoring with HNu, OVA, and Draeger tubes. If Draeger tubes indicate benzene or vinyl chloride greater than 1 unit, or if the OVA reads greater than 50 units above background, upgrade to level B.

**C** = Monitor atmosphere with HNu and OVA. Upgrade to level B if instrument response is greater than 50 units above background in the breathing zone or upon notification by Corporate Health and Safety and the SHSC.
5.2 PERSONNEL MONITORING: ORGANICS

All activities will commence in the primary level of protection listed in Table 5-1. The organic action levels are based on readings obtained with an HNu photoionization detector and/or a Foxboro flame ionization detector (OVA). Monitoring will emphasize breathing zone conditions. The breathing zone is defined as the hemisphere forward of the employee's shoulders, with a radius of approximately 6 to 9 inches from the nose.

An action level of 1 unit will trigger field personnel to upgrade to Level C and monitor specifically for benzene and vinyl chloride using a Draeger tube. Detection of benzene or vinyl chloride will force work to cease at that location until further evaluation of concentrations is made.

In the event that ambient breathing zone conditions exceed 50 units, as read by the HNu or OVA, workers will upgrade to level B. An upgrade to Level B will also be required should there be a reading of 0.5 ppm (or greater) recorded using Draeger tubes to detect vinyl chloride or benzene.

Calibration and maintenance checks of monitoring equipment will be performed daily. It is important for personnel to be aware of the effects of cold temperature on the accuracy of monitoring instruments. Appropriate preventive measures such as shielding and plastic bubble wrap should be used as necessary. Work will halt or a higher form of respiratory protection will be selected if monitoring instruments are rendered ineffective.
5.2.1 **Organic Action Levels**

Previous sampling results have been analyzed to develop the action levels listed. These action levels apply to all RI/FS activities.

<table>
<thead>
<tr>
<th>Units Above Background (OVA, HNu)</th>
<th>Level of Protection/Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>Level D/continue</td>
</tr>
<tr>
<td>≥1</td>
<td>Level C/test for benzene and/or vinyl chloride: Results greater than 0.5 ppm for vinyl chloride or benzene using Draeger tubes, then upgrade to Level B.</td>
</tr>
<tr>
<td>&gt;5-50</td>
<td>Level C/notify Corporate Health and Safety (Additional testing and/or upgrades may be necessary)</td>
</tr>
<tr>
<td>&gt;50-100</td>
<td>Level B</td>
</tr>
<tr>
<td>&gt;100</td>
<td>Halt work, re-evaluate conditions</td>
</tr>
</tbody>
</table>

5.3 **PERSONNEL MONITORING: EXPLOSIVE ATMOSPHERES/OXYGEN DEFICIENCIES**

A combination explosimeter and oxygen detector will be used to monitor lower explosive limit (LEL) and percent oxygen concentrations during intrusive activities.

5.3.1 **Action Levels: Explosimeter**

- <10% LEL -- Continue work.
- 10 to 20% LEL -- Continue monitoring and work with extreme caution. Keep all ignition sources away from work area.
- >20% LEL -- Evacuate work area.
5.3.2 **Action Levels: Oxygen Meter**

- 19.5 to 25% oxygen -- Continue work, monitor for L.E.L. conditions.
- <19.5 or >25% oxygen -- Evacuate work area.

5.4 **WORK AREA CONTROL TECHNIQUES**

At the drilling and monitor well location the FSO will divide the work area into three distinct zones. If appropriate, definition of these zones will be accomplished via banner guard or rope. The work zones are defined as follows:

Zone 1: **Exclusion Zone** -- the zone where contamination does or could exist. All personnel entering the Exclusion Zone must wear the level of protection specified for that work area. The number of personnel in this zone will be controlled and minimized.

Zone 2: **Contamination Reduction Zone (CRZ)** -- provides a transition zone between the Exclusion Zone and the Support Zone to prevent the spread of contaminants from the Exclusion Zone. Decontamination is performed in this zone.

Zone 3: **Support Zone** -- work area considered to be noncontaminated (located upwind of the Exclusion Zone). This is a storage area for support equipment and provides a point of personnel access and traffic control to the CRZ and Exclusion Zone.

5.5 **GENERAL SAFETY GUIDELINES**

- Personnel should sign a master sheet indicating they have read and understand the HSP and will comply.
- There will be no eating, drinking, or tobacco use in the Exclusion or Contamination Reduction Zones.
All personnel must pass through the Contamination Reduction Zone to enter or exit the Exclusion Zone.

A fire extinguisher will be at each work area for use on equipment or small fires only.

An adequately stocked first aid kit will be on scene at all times during field activities.

All visitors and unnecessary personnel will maintain a one boom-length distance from the drill rig and heavy equipment.

All project personnel will wash hands thoroughly before eating.

No contact lenses will be worn by personnel on-site.

5.6 PERSONNEL DECONTAMINATION

The following is a step-by-step description of decon procedures for Level D (see Figure 5-1), Level C (See Figure 5-2), and Level B (see Figure 5-3).

- Segregated equipment drop — All monitoring instruments, samples, hand tools and notebooks are dropped in this area, to be decontaminated by one of the decontamination team members. To aid in decontamination, instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants.

- Outer book cover and outer glove — Wash and rinse-scrub the outer disposable boot covers and outer gloves with a brush and water. Rinse the boot covers and glove covers. A 10% Clorox solution will be added to the rinse water as a bacterial disinfectant.
• Tape removal — Remove all sealing tape from around boots, gloves, zippers, etc. Dispose of tape in the disposable clothing drum.

• Outer boot cover and outer glove cover removal — Remove the outer boots and gloves by pulling down the items and exposing the clean inner lining. Dispose of the boots and gloves into the disposable equipment drum.

• Outer coverall removal — Unzip and remove the outer coverall.

• Face piece removal — Remove face piece and place in a designated area for further cleaning, see Respiratory Protection Program (Attachment A) for cleaning procedures.

• Inner glove removal — Remove inner gloves and dispose of into the disposable clothing drum. Remove inner coverall, if one is used, and wash hands and face.

• Personnel protective equipment will be placed in a labeled container and staged on-site pending disposal.

5.7 EQUIPMENT DECONTAMINATION

All field equipment to be used to conduct the RI at the Laurel Landfill will be decontaminated prior to performance of any work, between each use, and before leaving the site. It will be recommended that all filters and fluids of heavy equipment used for intrusive activities be...
changed prior to leaving the site. Specific procedures and protocols for the decontamination of equipment are presented in Section 4 of the RI/FS Sampling and Analysis Plan (SAP).
Step 1 Equipment drop

Step 2 Remove soil from safety boots

(Exclusion Zone)

---------------------------------HOT LINE---------------------------------

(Contaminated Reduction Zone)

Step 3 Remove cotton coveralls

Step 4 Hang up coveralls in designated area

Step 5 Wash hands

FIGURE 5-1 LEVEL D DECONTAMINATION
Step 1 Equipment drop

Step 2 Outer boot cover and outer glove rinse

Step 3 Tape removal

Step 4 Outer boot cover removal

Step 5 Outer glove removal

(Exclusion Zone)

-------------------HOT LINE-------------------

(Contaminated Reduction Zone)

Step 6 Disposable Tyvek suit removal

Step 7 Face piece removal

Step 8 Inner glove removal/disposal

Step 9 Wash hands

FIGURE 5-2 LEVEL C DECONTAMINATION
Step 1  Equipment Drop
Step 2  Boot Cover and Glove Wash
Step 3  Boot Cover and Glove Rinse
Step 4  Tape Removal
Step 5  Boot Cover Removal
Step 6  Outer Glove Removal

(Exclusion Zone)

----------------------------------------HOT LINE----------------------------------------

(Contaminated Reduction Zone)

Step 7  Suit/Safety Boot Wash
Step 8  Suit/SCBA/Boot/Glove Rinse
Step 9  Tank Change
Step 10 Safety Boot Removal
Step 11 SCBA Backpack Removal
Step 12 Splash Suit Removal
Step 13 Inner Glove Wash
Step 14 Inner Glove Rinse
Step 15 Face Piece Removal
Step 16 Inner Glove Removal
Step 17 Inner Clothing Removal

----------------------------------------EXCLUSION ZONE----------------------------------------

Step 18 Field Wash
Step 19 Redress

FIGURE 5-3 LEVEL B DECONTAMINATION
SECTION 6

EMERGENCY RESPONSE PLAN

It is essential that field personnel be prepared in the event of an emergency. Emergencies can take many forms: illnesses or injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather. The following subsections outline the general procedures for emergencies. Emergency information should be posted as appropriate.

6.1 EMERGENCY CONTACTS

Fire:              Laurel Fire Department          (302)875-3081 or 911
Police:           Laurel Police Department        (302)875-2244 or 911
Ambulance:        Sussex County Paramedics        911
Hospital:         Nanticoke Memorial              (302)629-6611

Directions to Nanticoke Hospital

From Laurel Landfill, take Route 494 East to Route 24. Turn left onto Route 24 East to Route 13 in Laurel. Take Route 13 North to Seaford. Turn left at the second traffic light in Seaford, onto Middleford Road. The hospital is approximately one-half mile on the left.
6.2 ADDITIONAL EMERGENCY NUMBERS

WESTON Health and Safety George Crawford On-call (24-hour) (215)430-7406 (215)692-3030

NIOSH: Health Hazard Evaluation (513)684-4382

OSHA: Technical Data Center (202)523-9700

Centers for Disease Control (404)329-3311 (404)329-2888

WESTON Central Equipment Stores 24-hour number (215)430-7440 (215)577-6768

6.3 EMERGENCY EQUIPMENT AVAILABLE ON-SITE

Communications Equipment Location
Public Telephones: Transfer Station Phone/Site Trailer (302)875-7050

Medical Equipment Location
First Aid Kits: Site Trailer
Inspection Date: (weekly) By: SHSC

Firefighting Equipment
Fire Extinguishers: Site Trailer/Drilling Rig
Inspection Date: Monthly By: SHSC
Other:

6.4 EMERGENCY CONTINGENCY PLAN

In the event of an emergency at the site, the SHSC will coordinate and initiate the Emergency Contingency Plan as applicable. Shutdown procedures will be initiated when activities are judged by the SHSC to involve an imminent danger condition. In the case of a major emergency, the SHSC will support the local fire/police service's response, as may be required. In the event the SHSC is not readily available to implement the Emergency Contingency Plan, the FSO may initiate procedures, provided the SHSC is informed at the earliest opportunity. Operations will also be shut down or curtailed in the event of minor spills or releases.

6.4.1 Implementation

The SHSC must assess possible hazards to human health or the environment that may result from any emergency situation. The Emergency Contingency Plan will be implemented in any of the following situations:

- Fire
  - A fire causes, or could cause, the release of toxic fumes and/or could spread to adjacent materials/resources.
  - An uncontrolled fire from areas that could threaten site activities.
  - Use of water and/or chemical fire suppressants that could result in uncontained contaminated runoff.
• Release of Hazardous Materials
  - The spill could cause the release of toxic vapors or fumes in concentrations higher than the PELs, IDLHs recommended by OSHA regulations, TLV criteria, or HSP levels.
  - A spill cannot be contained, resulting in a potential for soil, groundwater, and/or surface water contamination.

• Severe Weather Conditions Requiring Emergency Shutdown
  - A lightning storm is in the area (storm center less than 5 miles away).
  - A hurricane warning is in effect in the area.
  - Snow emergency has been declared in the area.

6.4.2 Emergency Response Procedures

• Emergency Signal: During the initial site health and safety briefing for each new site worker, an emergency signal (e.g., three long horn blasts) will be agreed to that will indicate a stop work and proceed to the designated gathering area, in accordance with the evacuation plan presented in Subsection 6.4.3.

• Account for All Personnel: The first priority during an emergency will be to account for all personnel. The SHSC will establish designated gathering points that will be shown to all IRP site personnel during orientation. The SHSC will check the gathering points to determine whether all personnel are present. Search and rescue efforts will begin immediately if all personnel are not present.

• Identification of Hazardous Materials: The SHSC will immediately identify the character, exact source, amount, and extent of any release. The initial identification method will be to visually analyze the material and location of the release. If for some reason the released material cannot be identified, samples will be taken for analysis.

• Hazard Assessment: The SHSC or FSO will assess possible hazards to human health or the environment that may result from a release, fire, or severe weather conditions. The SHSC will assess the hazards posed by an incident through the following steps, as appropriate:
  - First, identify the materials in the incident.
  - Second, consult appropriate references to determine potential adverse effects of exposure/release and appropriate safety precautions.
Third, identify exposure and/or release pathways and the quantities of material involved.

This assessment will consider both the direct and indirect effects of the release, fire, or severe weather conditions (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated; the effects of any hazardous surface water runoff caused by the water or chemical agents used to control fire or heat-induced explosions, etc.). Based on this assessment, the SHSC will determine what risk is posed to workers and neighboring populations. If the incident cannot be controlled by operating personnel without incurring undue risk, the SHSC will order the evacuation of all workers at risk and notify appropriate response agencies of the situation and the assistance required. If the SHSC determines that any persons outside the site are at risk as a result of the incident, the SHSC will contact the appropriate agencies and departments and advise them of the risk.

- **Fire:** When a fire on-site appears imminent or has occurred, all site activity will cease. The SHSC or FSO will assess the severity of the situation and decide whether or not the emergency is controllable with existing portable fire extinguishers, site equipment, or materials at hand. Fire fighting will not be done if the risk to operating personnel appears high. The local fire department will be called in these situations.

If the situation appears uncontrollable and poses a direct threat to human life, a warning will be sounded to all personnel to secure equipment and to immediately evacuate the area. The SHSC will alert all personnel when all danger has passed, as determined by fire department personnel.

- **Emergency Decontamination:** Emergency decontamination procedures are dependent on the situation and degree of hazard posed to site personnel by completing decontamination procedures. Decontamination procedures will be completed as well as they possibly can.

Partial decontamination or elimination of decontamination procedures is appropriate in cases of serious injury or high risk to personnel. In the event of serious injury, the employee should be wrapped, if possible, to reduce the degree of potential contamination which could be spread to other employees/emergency responders, equipment and clean areas. In case of such an injury, WESTON personnel will notify the emergency responder of the chemical hazards and accompany the injured person to the hospital.

- **Spill or Material Release:** If a hazardous waste or material release results in a probable vapor release, the information will be immediately relayed to the SHSC. The SHSC will assess the magnitude and potential seriousness of the release by reviewing the following information:

  - Safety data sheets of the material spilled or released, if known.
- Source of the release or spillage of hazardous material.

- An estimate of the quantity released and/or the rate at which the release continues.

- The direction in which the release is moving.

- Personnel who may have contacted materials or air contaminants, and the potential for injury or sickness as a result of the exposure.

- Potential for fire resulting from the release.

- Estimate of area under influence from the release.

In the event of an emergency spill or release, all personnel not involved with emergency response activity will be evacuated from the immediate area.

The area will be roped or otherwise blocked off. Evacuation procedures will be implemented based on air monitoring. Area activities will resume only after air monitoring has determined the area to be safe.

- **Suspect Asbestos Containing Materials:** In the event that any suspect asbestos-containing material is discovered during site activities, a sample of the material will be collected and submitted to an American Industrial Hygiene Association Accredited laboratory for analysis. The material will be thoroughly wetted and contained until laboratory results are received. If results are positive, the material will be disposed of in accordance with applicable regulations. Any release of asbestos materials will be reported to the appropriate agencies.

- **Prevention of Recurrence or Spread of Fire, Explosion, or Release:** The incident cause will be investigated by the SHSC. If a cause or likely cause can be established, necessary steps to eliminate or reduce the potential of a recurrence will be implemented. These changes will be identified in an amendment to this Emergency Contingency Plan. The SHSC will prepare an Incident Report and investigate as directed by Corporate Health and Safety.

- **Severe Weather Conditions Requiring Emergency Shutdown:** When a tornado or hurricane watch/warning has been issued or when high winds or a lightning storm occurs, the SHSC will institute emergency shutdown procedures in the case of a hurricane warning, and all personnel will proceed indoors after completing appropriate shutdown procedures. In the case of a lightning storm, procedures will be stopped, and all personnel will immediately proceed indoors. When the storm passes, the SHSC will inspect all equipment to ensure its readiness for operation.

- **Storage and Treatment of Released Material:** Immediately after an emergency, the SHSC will make arrangements for treatment, storage, or disposal of recovered
wastes and contaminated materials. Recovered wastes will be disposed of properly.

- **Post-Emergency Equipment Maintenance:** An inspection of all safety equipment will be conducted after an emergency event. All emergency equipment will be cleaned and be made serviceable, or be replaced if necessary, before operations are resumed.

- **Emergency Equipment:** The following list of firefighting, containment, and emergency equipment will be available at the work area:
  
  - Fire extinguishers -- dry chemical type 2ABC, 10ABC, and 20ABC. Type A is capable of extinguishing fires involving ordinary combustible material such as wood, cloth, paper, rubber, and many plastics. Type B is capable of extinguishing fires involving flammable liquids, oils, greases, tar, oil-base paints, lacquers, and flammable gas. Type C is capable of extinguishing fires involving energized electrical equipment. Type ABC is appropriate for all three types of fire. All extinguishers must comply with National Fire Code Standards for portable fire extinguishers. Fire extinguishers will be located in the drilling rig at any hot work location, and at the site trailer.

  - Spill or containment equipment located on the site includes:

    - Loose, dry absorbent (e.g., vermiculite or multipurpose sorbent).

    - Shovels with wooden handles, steel type. This equipment is to be used in the physical containment of any released hazardous constituents.

  - First aid supplies -- First aid kits meeting OSHA requirements for the work being conducted will be available in the site trailer and will include the following:

    - Bandages, gauze pads and rolls, adhesive tape.

    - Antibacterial ointments.

    - Splints.

    - Aspirin.

    - Local and topical anesthetics.

    - Eyewash bottle and solution.
6.4.3 **Evacuation Plan**

The first person recognizing an emergency situation that threatens human health or the environment will notify the SHSC, who will evaluate the situation for evacuation. The Evacuation Plan is as follows:

- Leave the area quickly by the nearest safe exit. Operating personnel are to escort visitors out of the immediate area. Personnel are to take note, before leaving, of where the emergency situation exists so they do not jeopardize their safety by walking into that area. All machinery will be shut off.

- Assemble in the area designated by the SHSC during the safety meeting for head count and further instructions.

- The SHSC will further direct actions, as necessary, and initiate the proper notification procedures for the agencies involved. No one is to return to the area unless so instructed by the SHSC or until the SHSC or other recognized official in charge issues an "all clear."

- Three levels of evacuation will be declared:
  
  A -- Evacuation of any areas beyond the landfill boundary that, in the opinion of the local fire/police service, are threatened by the subject incident.

  B -- Evacuation of immediate work areas and close surrounding areas.

  C -- Evacuation of immediate work area.

6.4.4 **Reports**

The SHSC will note, in appropriate site logs, the implementation of any portion of the Emergency Contingency Plan. The log entries will include:

- Date and time of the incident.
- Type of incident (e.g., fire, explosion, personnel injury).
- The number and nature of injuries.
- A description of the incident, including source, cause, actions taken, materials (and volumes involved), and other information appropriate for the incident.

The SHSC will:

- Report the incident to Corporate Health and Safety for further assistance and coordination with other agencies.
- Amend site work and safety plans, as applicable and appropriate, to eliminate or mitigate the possibility of recurrence.
### SECTION 7

**FIELD PERSONNEL SIGN-OFF**

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REFERENCES

ACGIH (American Conference of Governmental Industrial Hygienists), 1991-1992. Threshold Limit Values and Biological Exposure Indices. Cincinnati, OH.


OSHA (Occupational Safety and Health Administration) Permissible Exposure Limits (PELs), Title 29 Code of Federal Regulations Part 1910.1000.


APPENDIX A

HEALTH AND SAFETY FORMS
SUPPLEMENTARY RECORD OF OCCUPATIONAL INJURIES AND ILLNESSES

EMPLOYER (WESTON or Subcontractor)

1. Name ____________________________________________________________

2. Mail Address _____________________________________________________
   City State ZIP

3. Location, if different from mail address ______________________________

INJURED OR ILL EMPLOYEE

4. Name __________________ (First name) __________________ (Middle name) __________________ (Last name) S.S. No. ____________ / ______ /

5. Home Address ____________________________________________________
   No. and Street City or Town State Zip

6. Age _____ 7. Sex: Male ____ Female _____ Employee No. _____________

8. Occupation ________________________ (Enter regular job title, not job title at time of injury or exposure)

9. Department (Name & No.) ______________________________

THE ACCIDENT OR EXPOSURE TO OCCUPATIONAL ILLNESS

10. Place of accident or exposure ________________________________________
   (Give address or describe place injury occurred as accurately as possible)

11. Was place of accident or exposure on employee's premises? ____ (Yes or No)

12. What was employee doing when injured? _____________________________
   (Specify any tools/equipment/materials involved and what was being done)

13. How did the accident occur? _______________________________________
   (Describe fully the events which resulted in the injury or illness)

14. List names of witnesses: __________________________________________

15. Was the injury due to an automobile accident? _______ (Yes or No) If so, attach automobile accident report.

OCCUPATIONAL INJURY OR OCCUPATIONAL ILLNESS

16. Describe the injury or illnesses_______________________________________
   (Describe in detail and indicate the part of the body affected)

17. Name the object or substance which directly injured the employee ______

18. Date of injury or initial diagnosis of occupational illness _____________ Time of injury _____________
   Date of return to work ________ 19. Date/Time reported to Corporate Health & Safety __________________

20. Did the employee die? _______ (Yes or No)

NOTE: Complete Questions 1 through 29 and Send Via Fax (215)430-3167 within 48 Hours.
Forward completed report to Corporate Health and Safety Attorney's Office.
Incident Report Form
Case or File No. ___________________ Employee Name: ___________________

PROJECT/PROGRAM IDENTIFICATION
21. Work Order No. ___________________ or Program ID ___________________
22. Project Manager ___________________, Div/Reg OPs Manager ___________________
23. Div/Reg Operations Safety Officer ____________________________
24. Site/Project Health and Safety Coordinator _______________________

OTHER
25. List protective equipment and clothing used by employee ______________________
26. Did limitations of protective equipment/clothing contribute to injury/illness? If so, explain: ______________________
27. Name and Address of treating physician (also attach medical consultant's comments) ______________________
   - Indicate length of stay ______________________
28. If hospitalized, name and address of hospital ______________________
   - Indicate length of stay ______________________

CORRECTIVE ACTION
29. Explain corrective actions taken/to be taken which will prevent similar occurrences (attach additional pages if required): ______________________

DOCUMENTATION OF REVIEW
30. Employee Involved
   ____________________ (Name) ____________________ (Signature) ____________________ (Date)
31. Safety Management (Site Health and Safety Coordinator, and/or Regional or Divisional Operations Safety Officer)
   ____________________ (Name) ____________________ (Signature) ____________________ (Date)
32. Review by immediate supervisor and a minimum of one of the following:
   - Project Manager, Project Director, Department/Office Manager,
     Division/Regional Operations Manager, or Division/Region Manager
   ____________________ (Name) ____________________ (Signature) ____________________ (Date)
Incident Report Form

Case or File No. ___________  Employee Name: ___________

(FOR CORPORATE HEALTH AND SAFETY USE ONLY)

33. Initial Review by __________________________
   Name __________________________
   Date __________________________
   - Review and Comments: ____________________________________________________
     ____________________________________________________
     ____________________________________________________
     ____________________________________________________
     ____________________________________________________
     ____________________________________________________

33. Are additional corrective actions required? (Yes or No) List:
   ____________________________________________________
   ____________________________________________________
   ____________________________________________________
   ____________________________________________________

35. Date corrective actions accomplished: __________________________
   (Date Due __________)

36. Corporate Health and Safety Director
   __________________________
   (Name) __________________________
   (Signature) __________________________
   (Date) __________________________

INCIDENT ANALYSIS - Fin* Aid Only _______ OSHA Recordable _______

DATE | EMP # | DEPT # | OCCUPATION | DESCRIPTION | Fatal | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
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APPENDIX B

MATERIAL SAFETY DATA SHEETS
1 - Site Specific Information

No SITE SPECIFIC INFORMATION has been entered for this chemical

2 - PRODUCT IDENTIFICATION

PRODUCT NAME: METHANOL
FORMULA: CH3OH
FORMULA WT: 32.04
CAS NO.: 67-56-1
NIOSH/RTECS NO.: PC1400000
COMMON SYNONYMS: METHYL ALCOHOL; WOOD ALCOHOL; CARBINO; METHYLOL; WOOD SPIRIT
PRODUCT CODES: 9074, 9090, 5536, 9076, 9049, 9069, 9070, 9073, 5217, 9091, 9075, 9063
CHEMTREC # (800) 424-9300
NATIONAL RESPONSE CENTER # (800) 424-8802
J. T. BAKER INC.
222 RED SCHOOL LANE
PHILLIPSBURG, NJ 08865
24-HOUR EMERGENCY TELEPHONE -- (201) 859-2151
EFFECTIVE: 09/14/87
REVISION #05

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(*) SYSTEM

HEALTH - 3 SEVERE (POISON)
FLAMMABILITY - 3 SEVERE (FLAMMABLE)
REACTIVITY - 1 SLIGHT
CONTACT - 1 SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
FLAMMABLE
HARMFUL IF INHALED
2 - PRODUCT IDENTIFICATION (continued)

CANNOT BE MADE NON-POISONOUS
MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED
KEEP AWAY FROM HEAT, SPARKS, FLAME. DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH
ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE,
USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE.
FLUSH SPILL AREA WITH WATER SPRAY.

SAFETY DATA(*) STORAGE COLOR CODE: RED (FLAMMABLE)

3 - HAZARDOUS COMPONENTS

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<th>COMPONENT</th>
<th>%</th>
<th>CAS NO.</th>
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<tbody>
<tr>
<td>METHANOL</td>
<td>90-100</td>
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4 - PHYSICAL DATA

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<tbody>
<tr>
<td>BOILING POINT</td>
<td>65 °C (149 F)</td>
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<tr>
<td>MELTING POINT</td>
<td>-98 °C (-144 F)</td>
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<tr>
<td>SPECIFIC GRAVITY (H2O=1)</td>
<td>0.79</td>
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<tr>
<td>VAPOR PRESSURE (MM HG)</td>
<td>96</td>
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<tr>
<td>VAPOR DENSITY (AIR=1)</td>
<td>1.11</td>
</tr>
<tr>
<td>EVAPORATION RATE (BUTYL ACETATE=1)</td>
<td>4.6</td>
</tr>
<tr>
<td>SOLUBILITY (H2O)</td>
<td>COMPLETE (IN ALL PROPORTIONS)</td>
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<tr>
<td>VOLATILES BY VOLUME</td>
<td>100</td>
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<tr>
<td>APPEARANCE &amp; ODOR</td>
<td>CLEAR, COLORLESS LIQUID WITH CHARACTERISTIC PUNGENT ODOR.</td>
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5 - FIRE AND EXPLOSION HAZARD DATA

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<td>FLASH POINT (CLOSED CUP)</td>
<td>12 °C (54 F)</td>
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<tr>
<td>NFPA 704M RATING</td>
<td>1-3-0</td>
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<tr>
<td>FLAMMABLE LIMITS</td>
<td>UPPER - 36.0 %</td>
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</table>
5 - FIRE AND EXPLOSION HAZARD DATA (continued)

FIRE EXTINGUISHING MEDIA
USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED
BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.
MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER
TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK.
CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRON
OXIDIZERS MAY CAUSE FIRE.
BURNS WITH A CLEAR, ALMOST INVISIBLE FLAME.

TOXIC GASES PRODUCED
CARBON MONOXIDE, CARBON DIOXIDE, FORMALDEHYDE

6 - HEALTH HAZARD DATA

TLV LISTED DENOTES (TLV-SKIN).

THRESHOLD LIMIT VALUE (TLV/TWA): 260 MG/M3 (200 PPM)
SHORT-TERM EXPOSURE LIMIT (STEL): 310 MG/M3 (250 PPM)
PERMISSIBLE EXPOSURE LIMIT (PEL): 260 MG/M3 (200 PPM)

TOXICITY:
LD50 (ORAL-RAT) (MG/KG) - 5628
LD50 (IPR-RAT) (MG/KG) - 9540
LD50 (SCU-_MOUSE) (MG/KG) - 9800
LD50 (SKN-RABBIT) (G/KG) - 20

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL.
INHALATION MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, NARCOSIS,
SUDDEN DEATH, LOWER BLOOD PRESSURE, CENTRAL NERVOUS SYSTEM DEPRESSION.
CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION. PROLONGED SKIN CONTACT MAY
RESULT IN DERMATITIS. EYE CONTACT MAY RESULT IN TEMPORARY CORNEAL DAMAGE.
INGESTION MAY CAUSE BLINDNESS.
INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS,
6 - HEALTH HAZARD DATA (continued)

GASTROINTESTINAL IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSION AND HEARING LOSS.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE.

TARGET ORGANS
EYES, SKIN, CENTRAL NERVOUS SYSTEM, GI TRACT, RESPIRATORY SYSTEM, LUNGS

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
EYE DISORDERS, SKIN DISORDERS, LIVER OR KIDNEY DISORDERS

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT, ABSORPTION

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, IF CONSCIOUS, GIVE LARGE AMOUNTS OF WATER. INDUCE VOMITING.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

7 - REACTIVITY DATA

STABILITY: STABLE
HAZARDOUS POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION
INCOMPATIBILITIES: STRONG OXIDIZING AGENTS, STRONG ACIDS, ZINC, ALUMINUM, MAGNESIUM

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE, FORMALDEHYDE

8 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
BEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP
8 - SPILL AND DISPOSAL PROCEDURES (continued)

WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U154 (TOXIC WASTE)

9 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 200 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, RUBBER GLOVES ARE RECOMMENDED.

10 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(*) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS
BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

11 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)
11 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION (continued)

PROPER SHIPPING NAME METHYL ALCOHOL
HAZARD CLASS FLAMMABLE LIQUID
UN/NA UN1230
LABELS FLAMMABLE LIQUID
REPORTABLE QUANTITY 5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME METHANOL
HAZARD CLASS 3.2, 6.1
UN/NA UN1230
LABELS FLAMMABLE LIQUID, POISON

(*) AND (R) DESIGNATE TRADEMARKS.
N/A = NOT APPLICABLE OR NOT AVAILABLE

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* TRADEMARKS OF J.T.BAKER INC.
1 - Site Specific Information

No SITE SPECIFIC INFORMATION has been entered for this chemical

2 - PRODUCT IDENTIFICATION

PRODUCT NAME: NITRIC ACID
FORMULA: HNO3
FORMULA WT: 63.01
CAS NO.: 7697-37-2
NIOSH/RTECS NO.: QU5775000
COMMON SYNONYMS: HYDROGEN NITRATE; AZOTIC ACID
PRODUCT CODES: 9597,5113,9601,9602,5371,9598,9605,9600,4801,9616,9606
CHEMTREC # (800) 424-9300
NATIONAL RESPONSE CENTER # (800) 424-8802
J. T. BAKER INC
222 RED SCHOOL LANE
PHILLIPSBURG, NJ 08865
24-HOUR EMERGENCY TELEPHONE -- (201) 859-2151
EFFECTIVE: 05/27/88
REVISION #03

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(*) SYSTEM

HEALTH - 3 SEVERE (POISON)
FLAMMABILITY - 0 NONE
REACTIVITY - 3 SEVERE (OXIDIZER)
CONTACT - 4 EXTREME (CORROSIVE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
SPILLAGE MAY CAUSE FIRE OR LIBERATE DANGEROUS GAS
HARMFUL IF INHALED AND MAY CAUSE DELAYED LUNG INJURY
STRONG OXIDIZER - CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE
LIQUID AND VAPOR CAUSE SEVERE BURNS - MAY BE FATAL IF SWALLOWED OR INHALED
J.T. BAKER MSDS
MSDS for NITRIC ACID

2 - PRODUCT IDENTIFICATION (continued)

KEEP FROM CONTACT WITH CLOTHING AND OTHER COMBUSTIBLE MATERIALS. DO NOT STORE NEAR COMBUSTIBLE MATERIALS. DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE WATER SPRAY. IN CASE OF SPILL, NEUTRALIZE WITH SODA ASH OR LIME.

SAF-T-DATA(*) STORAGE COLOR CODE: YELLOW (REACTIVE)

3 - HAZARDOUS COMPONENTS

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>%</th>
<th>CAS NO.</th>
</tr>
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<tbody>
<tr>
<td>NITRIC ACID</td>
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<td>7697-37-2</td>
</tr>
<tr>
<td>WATER</td>
<td>29-35</td>
<td>7732-18-5</td>
</tr>
</tbody>
</table>

4 - PHYSICAL DATA

BOILING POINT: 121 C (250 F) VAPOR PRESSURE (MM HG): 9
MELTING POINT: -42 C (-44 F) VAPOR DENSITY (AIR=1): N/A
SPECIFIC GRAVITY: 1.41 (H2O=1) EVAPORATION RATE: N/A
(SYTHYL ACETATE=1)
SOLUBILITY (H2O): COMPLETE (IN ALL PROPORTIONS) VOLATILES BY VOLUME: 100
APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID. SUCCOCATING ACID ODOR.

5 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): N/A NFPA 704M RATING: 3-0-0 OXY
FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %
FIRE EXTINGUISHING MEDIA USE WATER SPRAY.
5 - FIRE AND EXPLOSION HAZARD DATA (continued)

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE EXPOSED CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL; DO NOT GET WATER INSIDE CONTAINERS.

UNUSUAL FIRE & EXPLOSION HAZARDS
STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. REACTS WITH MOST METALS TO PRODUCE HYDROGEN GAS, WHICH CAN FORM AN EXPLOSIVE MIXTURE WITH AIR.
A VIOLENT EXOTHERMIC REACTION OCCURS WITH WATER. SUFFICIENT HEAT MAY BE PRODUCED TO IGNITE COMBUSTIBLE MATERIALS.

TOXIC GASES PRODUCED
NITROGEN OXIDES, HYDROGEN GAS

6 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 5 MG/M3 (2 PPM)
SHORT-TERM EXPOSURE LIMIT (STEL): 10 MG/M3 (4 PPM)
PERMISSIBLE EXPOSURE LIMIT (PEL): 5 MG/M3 (2 PPM)
CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL.
INHALATION OF VAPORS MAY CAUSE SEVERE IRRITATION OR BURNS OF THE RESPIRATORY SYSTEM, PULMONARY EDEMA, OR LUNG INFLAMMATION.
INHALATION OF VAPORS MAY CAUSE COUGHING, CHEST PAINS, DIFFICULT BREATHING, AND UNCONSCIOUSNESS.
CONTACT WITH LIQUID OR VAPOR MAY CAUSE SEVERE IRRITATION OR BURNS OF THE SKIN, EYES, AND MUCOUS MEMBRANES.
INGESTION MAY CAUSE NAUSEA, VOMITING, AND SEVERE BURNS TO MOUTH, THROAT, AND STOMACH. PERFORATION OF GASTROINTESTINAL TRACT MAY RESULT.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE DAMAGE TO LUNGS AND TEETH.
6 - HEALTH HAZARD DATA (continued)

TARGET ORGANS
EYES, SKIN, MUCOUS MEMBRANES, RESPIRATORY SYSTEM, LUNGS, TEETH, GI TRACT
MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
DAMAGED SKIN, EYE DISORDERS, CARDIOPULMONARY DISEASE, LUNG DISEASE

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

7 - REACTIVITY DATA

STABILITY: STABLE  HAZARDOUS POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID:  HEAT, LIGHT, MOISTURE
INCOMPATIBILITIES:  STRONG BASES, CARBONATES, SULFIDES, CYANIDES, COMBUSTIBLE MATERIALS, ORGANIC MATERIALS, STRONG REDUCING AGENTS, MOST COMMON METALS, POWDERED METALS, CARBIDES, AMMONIUM HYDROXIDE, WATER, ALCOHOLS

DECOMPOSITION PRODUCTS: OXIDES OF NITROGEN, HYDROGEN

8 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. VENTILATE AREA. NEUTRALIZE SPILL WITH SODA ASH OR LIME. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN,
8 - SPILL AND DISPOSAL PROCEDURES (continued)

DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER. KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL.

J. T. BAKER NEUTRASORB(R) OR TEAM* 'LOW NA+' ACID NEUTRALIZERS ARE RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D001, D002 (IGNITABLE, CORROSIVE WASTE)

9 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 100 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ACID CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD. UNIFORM, PROTECTIVE SUIT, NEOPRENE GLOVES ARE RECOMMENDED.

10 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(*) STORAGE COLOR CODE: YELLOW (REACTIVE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE SEPARATELY AND AWAY FROM FLAMMABLE AND COMBUSTIBLE MATERIALS.
ISOLATE FROM INCOMPATIBLE MATERIALS.
KEEP PRODUCT OUT OF LIGHT.
11 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

**DOMESTIC (D.O.T.)**

<table>
<thead>
<tr>
<th>PROPER SHIPPING NAME</th>
<th>NITRIC ACID (OVER 40%)</th>
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<tr>
<td>HAZARD CLASS</td>
<td>OXIDIZER</td>
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<td>UN2031</td>
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<tr>
<td>LABELS</td>
<td>OXIDIZER, CORROSIVE</td>
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<tr>
<td>REPORTABLE QUANTITY</td>
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**INTERNATIONAL (I.M.O.)**

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</thead>
<tbody>
<tr>
<td>HAZARD CLASS</td>
<td>8</td>
</tr>
<tr>
<td>UN/NA</td>
<td>UN2031</td>
</tr>
<tr>
<td>LABELS</td>
<td>CORROSIVE</td>
</tr>
</tbody>
</table>

(* AND (R) DESIGNATE TRADEMARKS.
N/A = NOT APPLICABLE OR NOT AVAILABLE)

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APPENDIX C

DRILLING SAFETY GUIDE,
DRILL RIG INSPECTION CHECKLIST,
EQUIPMENT/TRUCKING INSPECTION CHECKLIST
2.5 DRILLING SAFETY GUIDE

2.5.1 An Introduction To Drilling Safety

The organization where you work is interested in your safety, not only when you are working on or around a drill rig, but also when you are traveling to and from a drilling site, moving the drill rig and tools from location to location on a site, or providing maintenance on a drill rig or drilling tools. This safety guide is for your benefit.

Every drill crew should have a designated safety supervisor. The safety supervisor should have the authority to enforce safety on the drilling site. A rig worker's first safety responsibility is to listen to the safety directions of the safety supervisor.

2.5.2 Governmental Regulations

All local, state, and federal regulations or restrictions, currently in effect or effected in the future, take precedence over the recommendations and suggestions that follow. Government regulations will vary from country to country and from state to state.

2.5.3 The Safety Supervisor

The safety supervisor for the drill crew, in most cases, will be the drill rig operator.

- The safety supervisor should consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.
- The safety supervisor should be the leader in using proper personal safety gear and set an example in following the rules that are being enforced on others.
- The safety supervisor should enforce the use of proper personal protective safety equipment and take appropriate corrective action when proper personal protective safety equipment is not being used.
- The safety supervisor should understand that proper maintenance of tools and equipment and general "housekeeping" on the drill rig will provide the environment to promote and enforce safety.
- Before drilling is started with a particular drill, the safety supervisor must be ensured that the operator (who may be the safety supervisor) has had adequate training and is thoroughly familiar with the drill rig, its controls, and its capabilities.
- The safety supervisor should inspect the drill rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses, and or damaged pressure gauges and pressure relief valves.

2.5-1
The safety supervisor should check and test all safety devices, such as emergency shutdown switches, at least daily and preferable at the start of a drilling shift. Drilling should not be permitted until all emergency shutdown and warning systems are working correctly. Do not wire ground, bypass or remove an emergency device. The safety supervisor should check that all gauges, warning lights, and control levers are functioning properly and listen for unusual sounds on each starting of an engine.

The safety supervisor should ensure that all new drill rig workers are informed of safe operating practices on and around the drill rig and should provide each new drill rig worker with a copy of the organization's drilling operations safety manual, and, when appropriate, the drill rig manufacturer's operations and maintenance manual. The safety supervisor should ensure that each new employee reads and understands the safety manual.

The safety supervisor should carefully instruct a crew worker in drilling safety and observe the new worker's progress towards understanding safe operating practices. The safety supervisor should observe the mental, emotional, and physical capability of each worker to perform the assigned work in a proper and safe manner. The safety supervisor should dismiss any worker from the drill site whose mental and physical capabilities might cause injury to the worker or coworkers.

The safety supervisor should ensure that there is a first-aid kit and a fire extinguisher on each drill rig and on each additional vehicle, and ensure that they are properly maintained.

The safety supervisor (and as many crew members as possible) should be well trained and capable of using first-aid kits, fire extinguisher, and all other safety devices and equipment.

The safety supervisor should maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.) and inform other members of the drill crew of the existence and location of the list.

2.5.4 Individual Protective Equipment

For most geotechnical, mineral, and/or groundwater drilling projects, individual protective equipment should include a safety hat, safety shoes, safety glasses and close fitting but comfortable, without loose ends, straps, draw strings or belts, or otherwise unfastened parts that might catch on some rotating or translating component of the drill rig. Rings and jewelry should not be worn during a work shift.
Safety Head Gear. Safety hats (hard hats) should be worn by everyone working or visiting at or near a drilling site. All safety hats should meet the requirements of ANSI Z89.1. All safety hats should be kept clean and in good repair with the headband and crown straps properly adjusted for the individual drill rig worker or visitor.

Safety Shoes or Boots. Safety shoes or boots should be worn by all drilling personnel and all visitors to the drill site observing drilling operations within close proximity of the drill rig. All safety shoes or boots should meet the requirements of ANSI Z41.1.

Gloves. All drilling personnel should wear gloves for protection against cuts and abrasion, which could occur while handling wire rope or cable and from contact with sharp edge and burrs on drill rods and other drilling or sampling tools. All gloves should be close fitting and not have large cuffs or loose ties that can catch on rotating or translating components of the drill rig.

Safety Glasses. All drilling personnel should wear safety glasses. All safety glasses should meet the requirements of ANSI Z87.1.

Other Protective Equipment. For some drilling operations, the environment or regulations may dictate that other protective equipment be used. The requirement for such equipment must be determined jointly by the management of the drilling organization and the safety supervisor. Such equipment might include face or ear protection or reflective clothing. Each drill rig worker should wear noise reducing ear protectors when appropriate. When drilling is performed in chemically-or radiologically-contaminated ground, special protective equipment and clothing may and probably will be required. The design and composition of the protective equipment and clothing should be determined as a joint effort of management and the client who requests the drilling services.

2.5.5 Housekeeping On and Around the Drill Rig

The first requirement for safe field operations is that the safety supervisor understands and fulfills the responsibility for maintenance and "housekeeping" on and around the drill rig.

Suitable storage locations should be provided for all tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.

Avoid storing or transporting tools, materials, or supplies within or on the mast (derrick) of the drill rig.
Pipe, drill rods, casing, augers, and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding.

- Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.
- Work areas, platforms, walkways, scaffolding and other accessways should be kept free of materials, debris and obstructions, and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- Controls, control linkages, warning and operation lights, and lenses should be stored free of oil, grease, and/or ice.
- Gasoline should not be stored in any portable container other than a non-sparking, red container with flame arrester in the fill spout and having the word "gasoline" easily visible.

2.5.6 Maintenance Safety

Good maintenance will make drilling operations safer. Maintenance should be performed safely.

- Wear safety glasses when performing maintenance on a drill rig or on drilling tools.
- Shut down the drill rig engine to make repairs or adjustments to a drill rig or to lubricate fitting (except repairs or adjustments that can only be made with the engine running). Take precautions to prevent accidentally starting of an engine during maintenance by removing or tagging the ignition key.
- Always block the wheels or lower the leveling jacks or both, and set hand brakes before working under a drill rig.
- When possible and appropriate, release all pressure on the hydraulic systems, the drilling fluid system, and the air pressure systems of the drill rig prior to performing maintenance. Reduce the drill rig and operating systems to a "zero energy state" before performing maintenance. Use extreme caution when opening drain plugs, radiator caps, and other pressurized plugs and caps.
- Do not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have had adequate time to cool.
- Never weld or cut on or near a fuel tank.
- Do not use gasoline or other volatile, flammable liquids as a cleaning agent on or around a drill rig.
- Follow the manufacturer's recommendations for applying the proper quantity and quality of lubricants, hydraulic oils, and/or coolants.

2.5-4
2.5.7 Safe Use Of Hand Tools

There are almost an infinite number of hand tools that can be used on or around a drill rig and in repair shops. "Use the tool for its intended purpose" is the most important rule of proper use. The following are a few specific and some general suggestions that apply to safe use of several hand tools often used on and around drill rigs:

- Wear safety glasses and require all others around you to wear safety glasses when using a hammer.
- Wear safety glasses and require all others around you to wear safety glasses when using a chisel.
- Keep all tools cleaned and orderly stored when not in use.
- Use wrenches on nuts - don't use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut - first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and when possible apply force to the wrench with both hands while both feet are firmly placed.
- Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing - check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease that would otherwise build up and cause wrenches to slip.
- Never use pipe wrenches in place of a rod holding device.
- Replace hook and heel jaws when they became visibly worn.
- Position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform when breaking tool joints on the ground or on the drilling platform; the wrench may slip or the joint may suddenly let go.

2.5.8 Clearing the Work Area

Prior to drilling, adequate site clearing and leveling should be performed to provide a safe working area for the drill rig and supplies. Drilling should not be commenced when tree limbs, unstable ground, or site obstructions cause unsafe tool handling conditions.
2.5.9 **Start-up**

- All drill rig personnel and visitors are instructed to "stand clear" of the drill rig immediately prior to and during starting of an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct nonactuating positions, and the cathead rope is not on the cathead before starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

2.5.10 **Safety During Drilling Operations**

Safety requires the attention and cooperation of every worker and site visitor.

- Do not drive the drill rig from hole to hole with the mast (derrick), in the raised position.
- Before raising the mast (derrick), check for overhead obstructions. (Refer to Section 2.5.11 an Overhead and Buried Utilities.)
- Before raising the mast (derrick), ensure all drill rig personnel (with exception of the operator) and visitors are cleared from the areas immediately to the rear and the sides of the mast. All drill rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, level, and stabilize the drill rig with leveling jacks and/or solid cribbing. The drill rig should be relveled if it settles after initial set-up. Lower the mast (derrick) only when the leveling jacks are down, and do not raise the leveling jack pods until the mast (derrick) is lowered completely.
- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.
- The operator of a drill rig will only operate a drill rig from the controls. If the operator of the drill rig must leave the area of the controls, the operator should shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator should shut down the drill engine before leaving the vicinity of the drill.
- Throwing or dropping tools is not permitted. All tools should be carefully passed by hand between personnel or a hoist line should be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.
• If it is necessary to drill within an enclosed area, make certain that exhaust fumes are conducted out of the area. Exhaust fumes can be toxic, and some cannot be detected by smell.
• Clean mud and grease from your boots before mounting a drill platform, and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
• During freezing weather, do not touch any metal parts of the drill rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
• Drain all air and water lines and pumps when not in use if freezing weather is expected.
• Cover all unattended boreholes or otherwise protect to prevent drill rig personnel, site visitors, or animals from stepping or falling into the hole. All open boreholes should be covered, protected, or backfilled adequately according to local or state regulations on completion of the drilling project.
• Do not "horse around" within the vicinity of the drill rig and tool and supply storage areas even when the drill rig is shut down.
• When using a ladder on a drill rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool "bucket" or a safety hook to raise or lower hand tools.

An elevated derrick platform should be used with the following precautions:

• When working on a derrick platform, use a safety belt and a lifeline. The safety belt should be at least 4 in. (100 mm) wide and should fit snugly but comfortably. The lifeline, when attached to the derrick, should be less than 6 ft (2 m) long. The safety belt and lifeline should be strong enough to withstand the dynamic force of a 250 lb (115 kg) weight (contained within the belt) falling 6 ft (2 m).
• When climbing to a derrick platform that is higher than 20 ft (6 m), use a safety climbing device.
• When a rig worker is on a derrick platform, fasten the lifeline to the derrick just above the derrick platform and to a structural member that is not attached to the platform or to other lines or cables supporting the platform.
• When a rig worker first arrives at a derrick platform, inspect the platform for broken members, loose connections and loose tools, or other loose materials. Securely attach tools to the platform with safety lines. Do not attach a tool to a line attached to your wrist or any other part of your body.

2.5-7
When you are working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.

Do not leave loose tools and similar items on the derrick platform or on structural members of the derrick.

Ensure that a derrick platform over 4 ft (1.2 m) above ground surface has toe boards and safety railings that are in good condition.

When working on the ground or the drilling floor, avoid being under rig workers on elevated platforms, whenever possible.

Be careful when lifting heavy objects:

- Before lifting any object without using a hoist, make sure the load is within your personal lifting capacity. If it is too heavy, ask for assistance.
- Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.
- If a heavy object must be moved some distance without the aid of machinery, keep your back straight and unarched. Change directions by moving your feet, not by twisting your body.
- Move heavy objects with the aid of hand carts whenever possible.

Drilling operations should be terminated during an electrical storm, and the complete crew should move away from the drill rig.

2.5.11 Overhead And Buried Utilities

The use of a drill rig on a site within the vicinity of electrical power lines and other utilities requires that special precautions be taken by both supervisors and members of the exploration crew. Electricity can shock, burn, and cause death.

- Locate, note, and emphasize all overhead and buried utilities on all boring location plans and boring assignment sheets.
- When overhead electrical power lines exist at or near a drilling site or project, consider all wires to be alive and dangerous.
- Watch for sagging power lines before entering a site. Do not lift power lines to gain entrance. Call the utility and ask them to lift or raise the lines or deenergize (turn off) the power.
Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest power line will be when the mast is raised and/or being raised. Do not raise the mast or operate the drill rig if this distance is less than 20 ft (6 m), or if known, the minimum clearance stipulated by federal, state, and local regulations. Keep in mind that both hoist lines and overhead power lines can be moved toward each other by the wind. Move the drill rig with the mast (derrick) down to avoid contact with power lines. If there are any questions whatever concerning the safety of drilling on sites in the vicinity of overhead power lines, call the power company. The power company will provide expert advice at the drilling site as a public service and at no cost.

Underground electricity is as dangerous as overhead electricity. Be aware and always suspect the existence of underground utilities such as electrical power, gas, petroleum, telephone, sewer and water. Ask for assistance:

- If a sign warning of underground utilities is located on a site boundary, do not assume that underground utilities are located on or near the boundary or property line under the sign: call the utility and check it out. The underground utilities may be considerable distance away from the warning sign.
- Always contact the owners of utility lines or the nearest underground utility location service before drilling. Determine jointly with utility personnel the precise location of underground utility lines, mark and flag the locations, and determine jointly with utility personnel what specific precautions must be taken to ensure safety.

2.5.12 Safe Use of Electricity

Drilling projects sometimes require around-the-clock operations and, therefore, require temporary electrical lighting. In general, all wiring and fixtures used to provide electricity for drilling operations should be installed by qualified personnel in accordance with the National Electrical Code (NFP A70-1984) with consideration of the American Petroleum Institute's recommended practices for electrical installations for production facilities (API-RP-500B). Lights should be installed and positioned to ensure that the work area and operating positions are well lit without shadows or blind spots. The following specific recommendations emphasize the safe use of electricity during land-bored drilling operations:
Before working on an electrical power or lighting system, lock out the main panel box with your own lock and keep the key on your person at all times.

Install all wiring using high quality connections, fixtures and wire, insulated and protected with consideration of the drilling environment. Makeshift wiring and equipment should not be permitted.

All lights positioned directly above working areas should be enclosed in cages or similar enclosures to prevent loose or detached lamps or vapor tight enclosures from failing on workers.

Install all lights to produce the least possible glare or "blind spots" on tools, ladders, walkways, platforms, and the complete working area.

Locate and guard all electrical cables to prevent damage by drill operations or by the movement of personnel, tools, or supplies.

Ensure that all plug receptacles are the three-prong, U-blade, grounded type and have adequate current carrying capacity for the electrical tools that may be used.

Ensure that all electric tools have three-prong, U-blade, ground wire plugs and cords.

Do not use electrical tools with lock-on devices.

Ensure that all electrical welders, generators, control panels, and similar devices are adequately grounded.

Avoid attaching electrical lighting cables to the derrick or other components of the drill rig. If this must be done, use only approved fasteners. Do not "string" wire through the derrick.

Do not use poles used to hold wiring and lights for any other purpose.

Power should be turned off before changing fuses or light bulbs.

When a drilling area is illuminated with electrical lighting, wear safety head gear that protects the worker's head, not only against falling or flying objects, but also against limited electrical shock and burn according to ANSI Z89.1 and Z89.2.

Ensure that all electrical equipment is operated by trained, designated personnel.

If you are not qualified to work on electrical devices or on electric lines, do not go near them.

### 2.5.13 React to Contact with Electricity

If a drill rig makes contact with electrical wires, it may or may not be insulated from the ground by the tires of the carrier. Under either circumstance, the human body, if it simultaneously comes in contact with the drill rig and the ground, will provide a conductor of the electricity to the ground. Death or serious injury can be the result. If a drill rig or a drill rig carrier makes contact with overhead or underground electrical lines:

2.5-10
• Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig.

• If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off - jump off, and do not hang on to the vehicle or any part of the drill when jumping clear.

• If you are on the ground, you should stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig, and seek assistance from local emergency personnel such as the police or a fire department.

• When an individual is injured and in contact with the drill rig or with power lines, only rescue with extreme caution. If a rescue is attempted, use a long, dry, unpainted piece of wood or a long, dry, clean rope. Keep as far away from the victim as possible and do not touch the victim until the victim is completely clear of the drill rig or electrical lines.

• When the victim is completely clear of the electrical source and is unconscious and a heart beat (pulse) cannot be detected, cardiopulmonary resuscitation (CPR) should be begun immediately.

2.5.14 Safe Use of Wire Line Hoists, Wire Rope and Hoisting Hardware

The use of wire line hoists, wire rope, and hoisting hardware should be as stipulated by the American Iron and Steel Institute Wire Rope Users Manual.

• All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for: abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardware. Wire ropes should be replaced when inspection indicates excessive damage according to the Wire Rope Users Manual. All wire ropes that have not been used for a period of a month or more should be thoroughly inspected before being returned to service.

• End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer's instructions and loaded according to the manufacturer's specifications.
• If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to ensure that the swivel freely rotates under load.

• If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1 ft (0.3 m) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints, and do not make up, tighten, or loosen tool joints while the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to brake the fall of the rods with your hands or by tensioning the slipping device.

• Most sheaves on exploration drill rigs are stationary with single part line. The number of parts of line should not ever be increased without first consulting with the manufacturer of the drill rig.

• Wire ropes must be properly matched with each sheave - if the rope is too large, the sheave will pinch the wire rope - if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger sized wire rope.

The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware:

• Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool handling hoists to pull on objects away from the drill rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.

• When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.

• When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.

• Minimize shock loading of a wire rope apply loads smoothly and steadily.

• Avoid sudden loading in cold weather.

• Never use frozen ropes.

• Protect wire rope from sharp corners or edges.

• Replace faulty guides and rollers.

• Replace worn sheaves or worn sheave bearings.

• Know the safe working load of the equipment and tackle being used. Never exceed this limit.
Periodically inspect and test clutches and brakes of hoists.
Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.
Always wear gloves when handling wire ropes.
Do not guide wire rope on hoist drums with your hands.
Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or property are created.
Never leave a load suspended in the air when the hoist is unattended.
Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up, and when the load is being hoisted.
Never hoist the load over the head, body, or feet of any personnel.
Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
Replace wire ropes with ones that conform to the drill rig manufacturer's specifications.

2.5.15 Safe Use of Cathead and Rope Hoists

The following safety procedures should be employed when using a cathead hoist:

- Keep the cathead clean and free of rust and oil and/or grease. The cathead should be cleaned with a wire brush if it becomes rusty.
- Check the cathead periodically, when the engine is not running, or rope wear grooves. If a rope groove forms to a depth greater than 1/8 inch (3 mm), the cathead should be replaced.
- Always use a clean, dry, sound rope. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.
- Should the rope "grab" the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator should also back away and stay clear. If the rope "grabs" the cathead, and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator should keep careful watch on the suspended tools and should quickly back away after turning off the engine.

2.5-13
Protect the rope from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.

Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg, or any other part of your body.

Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum when driving samplers, casing or other tools with the cathead and rope method. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground.

Never operate a cathead (or perform any other task around a drill rig) with loose, unbuttoned, or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.

Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.

Do not use more rope wraps than are required to hoist a lead.

Do not leave a cathead unattended with the rope wrapped on the drum.

Position all other hoist lines to prevent contact with the operating cathead rope.

When using the cathead and rope for driving or back-driving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.

The cathead operator must operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

2.5.16 Safe Use of Augers

The following general procedures should be used when starting a boring with continuous flight or hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low RPM.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation central at all times until the auger has penetrated about one foot or more below ground surface.

2.5-14
Use the auger guide to facilitate the starting of a straight hole through hard ground or a pavement.

The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.

- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench, or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

2.5.17 Safety During Rotary And Core Drilling

Rotary drilling tools should be safety checked periodically and replaced when necessary.

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- Drill rod chuck jaws should be checked periodically and replaced when necessary.
- The capacities of hoists and sheaves should be checked against the anticipated weight to the drill rod string plus other expected hoisting loads.

Special precautions that should be taken for Safe rotary or core drilling involve chucking, joint break, hoisting, and lower of drill rods:

- Only the operator of the drill rig should brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.

2.5-15
Drill rods should not be braked during lowering into the hole with drill rod chuck jaws.
Drill rods should not be held or lowered into the hole with pipe wrenches.
If a string of drill rods are accidentally or inadvertently released into the hole, an attempt should not be made to grab the falling rods with your hands or a wrench.
In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.
If work must progress over a portable drilling fluid (mud) pit, no one should attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

2.5.18 Safety During Travel

The individual who transports a drill rig on and off a drilling site should:

- Be properly licensed and should only operate the vehicle according to federal, state, and local regulations.
- Know the traveling height (overhead clearance), width, length, and weight of the drill rig with carrier and know highway and bridge load, width and overhead limits, making sure these limits are not exceeded with an adequate margin.
- Never move a drill rig unless the vehicle brakes are in sound working order.
- Allow for most overhang when cornering or approaching other vehicles or structures.
- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.
- Watch for low hanging electrical lines, particularly at the entrances to drilling sites, restaurants, motels, or other commercial sites.
- Never travel on a street, road, or highway with the mast (derrick) of the drill rig in the raised or partially raised position.
- Remove all ignition keys when a drill rig is left unattended.

2.5-16
2.5.19 Loading and Unloading

When loading or unloading a drill rig on a trailer or a truck:

- Use ramps of adequate design that are solid and substantial enough to bear the weight of the drill rig with carrier - including tooling.
- Load and unload on level ground.
- Use the assistance of someone on the ground as a guide.
- Check the brakes on the drill rig carrier before approaching loading ramps.
- Distribute the weight of the drill rig, carrier, and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the hitch of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.
- Secure drill rig and tools to the hauling vehicle with ties, chains, and/or load binders of adequate capacity.

2.5.20 Off-Road Movement

The following safety suggestions relate to off-road movement:

- Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gullies, ruts and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven, or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4 x 4, 6 x 6, etc. vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Do not attempt to cross obstacles such as small logs and small erosion channels or ditches at an angle.
- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.
- After the drill has been moved to a new drilling site, set all brakes and/or locks. When grades are steep, block the wheels.
- Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.
2.5.21 Tires, Batteries And Fuel

Tires on the drill rig must be checked daily for safety and during extended travel for loss of air, and they must be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be reinflated to normal pressures before movement on firm or hilly ground or on streets, roads, and highways. Under-inflated tires are not as stable on firm ground as properly-inflated tires. Air pressures should be maintained for travel on streets, roads, and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs.
- Objects wedged between duals or embedded in the tire casing.
- Damage to or poorly fitting rims or rim flanges.
- Abnormal or uneven wear and cuts, breaks, or tears in the casing.

The repair of truck and off-highway tires should only be made with required special tools and following the recommendations of a tire manufacture's repair manual.

Batteries contain strong acid. Use extreme caution when servicing batteries.

- Service batteries in a ventilated area while wearing safety glasses.
- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
- When installing a battery, connect the battery ground clamp last.
- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger loads to the battery posts. Cell caps should be loosened prior to charging to permit the escape of gas.
- Spilled battery acid can burn your skin and damage your eyes. Immediately flush spilled battery acid off of your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a medical physician at once.
- To avoid battery explosions, keep the cells filled with electrolyte, use a flashlight (not an open flame) to check electrolyte levels, and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.
Special precautions must be taken for handling fuel and refueling the drill rig or carrier.

- Only use the type and quality of fuel recommended by the engine manufacturer.
- Refuel in a well-ventilated area.
- Do not fill fuel tanks while the engine is running. Turn off all electrical switches.
- Do not spill fuel on hot surfaces. Clean any spillage before starting an engine.
- Wipe up spilled fuel with cotton rags or cloths - do not use wool or metallic cloth.
- Keep open lights, lighted smoking materials, and flames or sparking equipment well away from the fueling area.
- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.
- Do not fill portable fuel containers completely full to allow expansion of the fuel during temperature changes.
- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.
- Keep fuel containers and hoses in contact with a metal surface during travel to prevent the buildup of static charge.

2.5.22. First Aid

At least one member of the drill crew, preferably the drilling safety supervisor, should be trained to perform first aid. First aid is taught on a person-to-person basis, not by providing or reading a manual. Manuals should only provide continuing reminders and be used for reference. It is suggested that courses provided or sponsored by the American Red Cross or a similar organization would best satisfy the requirements of first aid training for drill crews.

For drilling operations, it is particularly important that the individual responsible for first aid should be able to recognize the symptoms and be able to provide first aid for electrical shock, heart attack, stroke, broken bones, eye injury, snake bite, and cuts or abrasions to the skin. Again, first aid for these situations is best taught to drill crew members by instructors qualified by an agency such as the American Red Cross.

A first aid kit should be available and well maintained on each drill site.

2.5.23 Drill Rig Utilization

Do not attempt to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc. Only use the drill rig and tools for the purposes that they are intended and designed.

2.5-19
2.5.24 Drill Rig Alterations

Alterations to a drill rig or drilling tools should only be made by qualified personnel and only after consultation with the manufacturer.
DRILL RIG INSPECTION CHECKLIST

Answer Yes or No, and make any additional comments you feel are necessary. Portions of this checklist should be filled out during drilling operations.

A. GENERAL HEALTH AND SAFETY

1. Does the Health and Safety Plan (HASP) address drilling hazards?  
   Comments: _________________________________________

2. Have the hazards of drilling been communicated to all field personnel?  
   Comments: __________________________________________

3. Have the drillers been informed not to wear rings, loose fitting clothes, straps, draw strings, or other items which may catch in rotating or moving parts?  
   Comments: __________________________________________

4. Do all field personnel know where the emergency shut off is for the rig?  
   Comments: __________________________________________

5. Has the drill crew been informed that only qualified drillers may operate the rig?  
   Comments: __________________________________________

6. Have all field personnel been informed of the location of posted information, i.e., hospitals, emergency phone numbers, evacuation routes?  
   Comments: __________________________________________

7. Do all field personnel know the location of safety equipment, i.e., first aid kits, fire extinguishers?  
   Comment: ___________________________________________
8. Do drillers know the air monitoring scheme, i.e., when samples are to be taken? ____

Comments: _______________________________________

9. Have the geologist and the drill crew established and/or been informed of the method for signaling an emergency? ____

Comment: _______________________________________

B. PERSONAL PROTECTIVE EQUIPMENT

1. Do drillers have hard hats, safety glasses, and steel toed boots? ____

Comments: ______________________________________

2. Does this equipment meet ANSI standards?
   Hard hat (ANSI Z81.1) ____; safety glasses (ANSI Z87.1) ____;
   steel toed boots (ANSI Z41.1) ____

Comments: _______________________________________

3. Do drillers have hearing protection available? ____

Comments: _______________________________________

4. Do drillers have the personal protective equipment required in case of upgrade? ____

Comment: _______________________________________

5. If respirators stored on the rig, are they clean and stored in plastic bags in a dry, safe place such that rubber components are not distorted? ____

Comments: _______________________________________

6. Do drillers have gloves that are durable and will protect them from the chemical hazards? ____

Comments: _______________________________________

2.6-2
7. Do the drillers have the correct respirator cartridge, as stated in the HASP? 

Comments: ____________________________________________

8. Is this equipment used according to OSHA 29 CFR 1910.134? 

Comments: ____________________________________________

C. HOUSEKEEPING

1. Is there adequate storage area for tools, augers, pipe, etc.? 

Comments: ____________________________________________

2. Are pipes, augers and rods stacked in an area where they cannot roll or slide? 

Comment: _________________________________________________________

3. Are work areas and platforms free of tools, debris, and slick substances such as ice, mud, and grease? 

Comments: ____________________________________________

4. Are controls free of slick substances such as mud, grease, and ice? 

Comment: ____________________________________________

5. Is gasoline stored in OSHA approved containers? 

Comments: ____________________________________________

D. MAINTENANCE

1. Do the drillers have a rig inspection program? 

Comments: ____________________________________________

2. Are the inspections documented? 

Comments: ____________________________________________

2.6-3
3. How often are the inspections performed? ____
   Comments: ____________________________________________________________
   __________________________________________________________

4. Who performs the inspections? ____
   Comments: ____________________________________________________________
   __________________________________________________________

5. Do the drillers perform daily checks on the equipment? ____
   Comments: ____________________________________________________________
   __________________________________________________________

E. RIG EQUIPMENT

1. Are parking brakes available and in use when the equipment is not in use? ____
   Comments: ____________________________________________________________
   __________________________________________________________

2. Are lights, mirrors, windshields and side windows in good condition and operational? ____
   Comments: ____________________________________________________________
   __________________________________________________________

3. Are back-up alarms and warning signals operational? ____
   Comments: ____________________________________________________________
   __________________________________________________________

4. Are mud flaps in place and in good condition? ____
   Comments: ____________________________________________________________
   __________________________________________________________

5. Are the necessary protective guards maintained in place where injury may result? ____
   Comments: ____________________________________________________________
   __________________________________________________________

6. Are cables in good condition and inspected often for, birdcaging, kinks, and flattened areas? ____
   Comments: ____________________________________________________________
   __________________________________________________________

2.6-4
7. Are other signs of wear apparent, such as broken or cut wires on the cable? 
   Comments: 

8. Do pulleys operate freely and are cable guards maintained in place? 
   Comments: 

9. Are cable eyes formed and constructed properly? 
   Comments: 

10. Are at least three saddle clips installed and spaced properly, with the "U" section of the clip on the dead end of the rope? 
    Comments: 

11. Are pulleys the proper size for the cable diameter? 
    Comments: 

12. Is the rope to the slide hammer free of worn or burned spots? 
    Comments: 

13. Are hydraulic lines in good condition and fittings tight? 
    Comments: 

14. Are hydraulic slides and guides lubricated adequately and frequently? 
    Comments: 

15. Is the cat head lubricated frequently during use to avoid damaging the rope? 
    Comments: 

2.6-5
16. Is the emergency shut off system working properly? ____  
Comments: ____________________________________________________________  

17. Is there a first aid kit with a daily inspection log on the rig? ____  
Comments: ____________________________________________________________  

18. Is there a 20 B-C fire extinguisher with a current inspection tag available in the work area? ____  
Comments: ____________________________________________________________  

F. CUTTING TORCHES AND WELDING

1. Are drillers who are using cutting/welding equipment properly trained or experienced? ____  
Comments: ____________________________________________________________  

2. Are hoses in good shape, with no cuts or worn spots? ____  
Comments: ____________________________________________________________  

3. Are oxygen and acetylene tanks used, stored upright and secured from dropping or falling? ____  
Comments: ____________________________________________________________  

4. Are oxygen, acetylene and other fuel tanks stored at least 25' apart when not in use? ____  
Comments: ____________________________________________________________  

5. Are appropriate eye shades provided? ____  
Comments: ____________________________________________________________  

6. Is a wrench provided for operating the valves on the tank? ____  
Comments: ____________________________________________________________  

2.6-6
7. Are potentially toxic coatings removed from the materials prior to cutting/welding? ____
   Comments: ____________________________________________

8. Is adequate ventilation provided when cutting/welding? ____
   Comments: ____________________________________________

9. Are electric cables and connectors in good shape? ____
   Comments: ____________________________________________

10. Is appropriate protective clothing worn when welding? ____
    Comments: ____________________________________________

11. Are combustible materials kept away from the area while welding activities are in progress? ____
    Comments: ____________________________________________

12. Is a Hot Work Permit program in effect when cutting/welding is performed? ____
    Comments: ____________________________________________

G. HAND TOOL SAFETY

1. Are hand tools being used for their designed? ____
   Comments: ____________________________________________

2. Are tools checked for signs of stress: cracked handles ____; loose handles ____; cracked or mushroomed metal ____; tips or points properly sharpened ____; wrenches ____; worn gripping surfaces ____.
   Comments: ____________________________________________

3. Are safety glasses being worn when hand tools that may produce flying fragments are in use? ____
   Comments: ____________________________________________

2.6-7
4. Are wrenches being used on nuts and bolts (pliers or pipe wrenches should not be used)?

Comments: ____________________________________________________________

5. Are pipe wrenches and other hand tools clean and in good condition?

Comments: ____________________________________________________________

H. ELECTRICITY AND POWER TOOLS

1. Is low voltage equipment used in tanks and wet area?

Comments: ____________________________________________________________

2. Are tools maintained, inspected and in good condition?

Comments: ____________________________________________________________

3. Are electrical tools and instruments approved for use in hazardous areas? Yes, good for Class____, Division ____, Groups ____

Comments: ____________________________________________________________

4. Is the insulation on cords in good condition, and plugs unbroken?

Comments: ____________________________________________________________

5. Are extension and power cords protected from vehicular traffic?

Comments: ____________________________________________________________

6. Has the grounding prong on any three prong plug been cut off? If not, is the extension cord made for a ground plug?

Comments: ____________________________________________________________
7. Are guards in place on portable electric tools?
   Comments: __________________________________________________

I. SAFETY DURING SETUP AND DRILLING

1. Is banner-guard used to delineate the area around the rig (standard is one derrick length)?
   Comments: __________________________________________________

2. Is the derrick lowered when the rig is moved from one place to another?
   Comments: __________________________________________________

3. Have overhead and buried utilities been located and marked before drilling begins?
   Comments: __________________________________________________

4. Are all personnel (except drillers) cleared from the rear of and the sides of the rig when the derrick is being raised?
   Comments: __________________________________________________

5. Are the jack pods lowered and leveled before the derrick is lowered?
   Comments: __________________________________________________

6. Before drilling begins, is the derrick locked into place?
   Comments: __________________________________________________

7. Does the driller shut down the operation of the rig when he is not at the controls?
   Comments: __________________________________________________

8. Are open holes covered when left unattended?
   Comments: __________________________________________________

2.6-9
9. Are drillers restricted from climbing the derrick? ____ If not do they use safety belts or harnesses? ____

Comments: ____________________________________________________________

10. Are all drilling operations shut down and workers required to be in safe locations during electrical storms? ____

Comments: ____________________________________________________________

11. Are drillers aware that the derrick must be a minimum of 20' from overhead power lines? ____

Comments: ____________________________________________________________

12. Have underground surveys been performed before drilling at each location? ____

Comments: ____________________________________________________________

13. If drilling is allowed after dusk, are 5 footcandles of light provided? ____

Comments: ____________________________________________________________

14. Is the entire drilling area illuminated so that personnel may see the hazards? ____

Comments: ____________________________________________________________

NOTE: Drilling after dusk is not recommended. Car headlights are not an acceptable means of illumination.