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Environmental Restoration Program

AREA B, OPERABLE UNIT 1 PROPOSAL FOR ADDITIONAL FIELD WORK

VOLUME II – HEALTH AND SAFETY PLAN

MOUND PLANT
MIAMISBURG, OHIO

September 1992

FINAL

Department of Energy
Albuquerque Field Office

Environmental Restoration Program
Technical Support Office
Los Alamos National Laboratory

REFERENCE USE ONLY

ENVIRONMENTAL RESTORATION PROGRAM

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
OPERABLE UNIT 1, PROPOSAL FOR ADDITIONAL WORK
HEALTH AND SAFETY PLAN

MOUND PLANT
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DEPARTMENT OF ENERGY
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ENVIRONMENTAL RESTORATION PROGRAM
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FINAL
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REPLACEMENT PAGES

Health and Safey Plan

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APPENDIX A

Replaces all pages.

APPENDIX B

Add SOP 6.11.

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ACRONYMNS

ACGIH	American Conference of Governmental Industrial Hygenists
ALARA	as low as reasonably achievable
BVA	Buried Valley aquifer
CGI	combustible gas indicator
DAC	derived air concentration
DAO	Dayton Area Office
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration (Program)
FID	flame ionization detector
FIDLER	field instrument for the detection of low-energy radiation
HASP	Health and Safety Plan
NCRP	National Council on Radiation Protection and Measurements
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PID	photoionization detector
RAM	real-time aerosol monitor
RI/FS	remedial investigation/feasibility study
RPM	Remedial Program Manager
SHSC	site health and safety coordinator
SOP	Standard Operating Procedure
SSL	site sanitary landfill
TSO	Technical Support Office
VOC	volatile organic compound

1. INTRODUCTION

This Health and Safety Plan (HASP) is one component of the Operable Unit 1 Proposal for Additional Work prepared for the U.S. Department of Energy (DOE) Mound Plant. It has been prepared as required by the Federal Facilities Agreement for Mound Plant and follows the format recommended by the U.S. Environmental Protection Agency (EPA) for remedial investigations/feasibility studies (RI/FS) (EPA 1988). It complies with the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR 1910.120 for investigations at hazardous waste sites (CFR 1990). This plan provides information on the following topics:

- key health and safety personnel,
- risk analysis (site hazards),
- worker training,
- personal protective equipment,
- medical surveillance requirements,
- frequency and types of monitoring,
- site control measures,
- decontamination procedures,
- standard operating procedures (SOPs) for the site, and
- contingency plans.

This plan provides information applicable to the Operable Unit 1 Proposal for Additional Work at Mound Plant, which is being prepared under the Environmental Restoration (ER) Program, and it addresses the hazards associated with Operable Unit 1, site-specific sampling. Operable Unit 1 includes a historical waste disposal area, Area B (landfill), from which there has been a known release of volatile organic compounds (VOCs) to the Buried Valley aquifer (BVA). The proposed work area is shown in Figure 1.1. The Operable Unit 1 Proposal for Additional Work defines six specific investigations to be conducted. An additional activity is decontaminating equipment within each investigation to prevent cross contamination from occurring. This HASP will be structured so that field personnel will easily be able to identify specific hazards and their monitoring requirements for each activity. The six activities are as follows:

1. soil gas sampling within the site sanitary landfill (SSL) area, including excavation to expose french drains, and leveling and benching of the SSL berm;

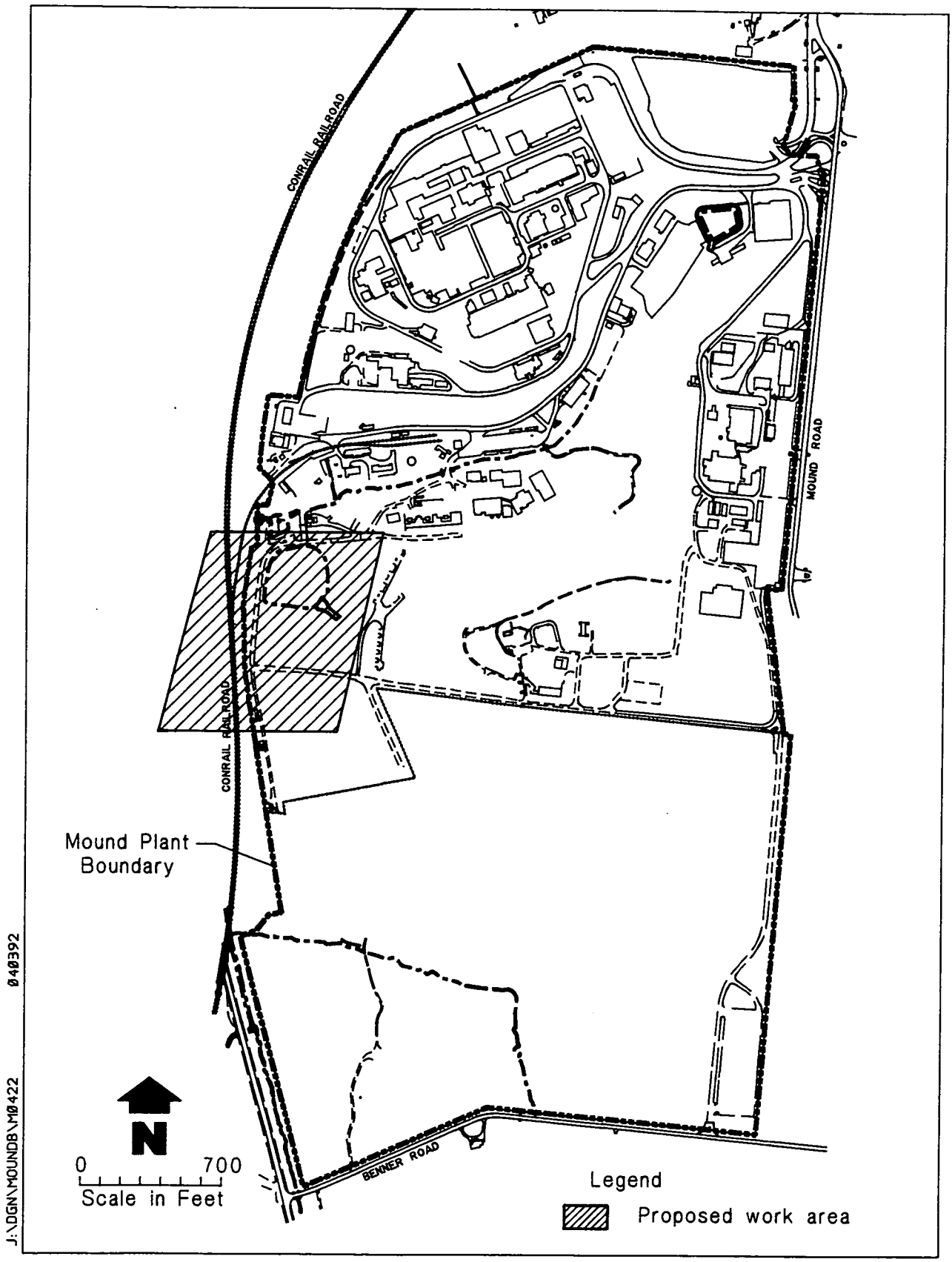

Figure 1.1. Proposed work area.

2. drilling and sampling of boreholes, and installation of piezometers and monitoring wells

3. overdrilling existing boreholes and installing surface casing with a cable-tool drill rig

4. shallow soil sampling

5. conducting an aquifer test

6. decontamination

This ER Program HASP has been reviewed by Mound Plant personnel to ensure that it is compatible with the Mound Plant organization and has been accepted. Workers participating in the above activities will read this plan and sign the sheet in Appendix A. Confined space entry is not planned for the Operable Unit 1 Additional Work and, therefore, is not mentioned in this plan.

2. POLICY AND STANDARDS

The DOE is responsible for health, safety, and environmental protection programs at DOE-owned, contractor-operated facilities. DOE is mandated to conduct the ER Program in a manner that will limit risks to the health and safety of employees and the general public and that will provide adequate protection for property and the environment. Specific procedures may include engineering controls, administrative controls, and the use of equipment for personal protection.

One of the main tenets of this HASP is that exposures of workers to radiation and toxic materials must be kept to levels as low as reasonably achievable (ALARA). Health physicists and industrial hygienists help in meeting this goal by participating in the planning of tasks and by providing ALARA reviews of all project work plans. These ALARA reviews ensure that all reasonable efforts have been made to minimize exposures to workers and the general public.

The environmental, health, and safety protection requirements that apply to remedial investigations under the ER Program are described in DOE and DOE Albuquerque Operations Office orders. This site-specific HASP is based on these orders and follows applicable federal, state (Ohio), and local standards.

3. HEALTH AND SAFETY RESPONSIBILITIES

The ER Program subcontractor Health and Safety manager is responsible for oversight of the health and safety programs at ER Program sites. At Mound Plant, the ER Program subcontractor installation manager and site manager are responsible for site worker safety. The ER Program subcontractor site health and safety coordinator (SHSC) provides guidance to the site manager regarding potential health

hazards during characterization activities. As with all field activities, field personnel must be aware of potential hazards at all times. Reporting responsibilities are shown on the flowchart in Figure 3.1.

3.1. INSTALLATION RESPONSIBILITIES

The Mound Plant Safety and Loss Prevention Department has primary responsibility for implementing health and safety requirements according to installation procedures. The managers of this department will guide the ER Program site manager in establishing health and safety requirements that are consistent with current Mound Plant policies and standards. They will also ensure that a Mound Plant health physicist is present to perform radiological monitoring when required by Mound Plant procedures.

3.2. ER PROGRAM SUBCONTRACTOR PERSONNEL RESPONSIBILITIES

3.2.1. ER Program Subcontractor Installation Manager

The Subcontractor Installation Manager is responsible for the following:

- ensuring compliance with the HASP and ensuring a safe work environment for the field team members;
- assigning a SHSC to ensure compliance with this site HASP;
- being familiar with emergency response procedures and notification requirements and implementing them as needed; and
- ensuring coordination of field activities with the Mound Plant Safety and Loss Prevention Department.

3.2.2. ER Program Subcontractor Health and Safety Manager

The ER Program Subcontractor Health and Safety Manager is responsible for the following:

- reviewing the Operable Unit 1 HASP and any modifications or addenda to the plan;
- providing technical guidance to the SHSC;
- conducting health and safety audits of site activities, submitting reports of the findings, and approving the resolutions to the findings; and
- overseeing the investigation and reporting of any accidents involving subcontractor personnel; and
- acting as a backup to the SHSC in the event of an emergency.

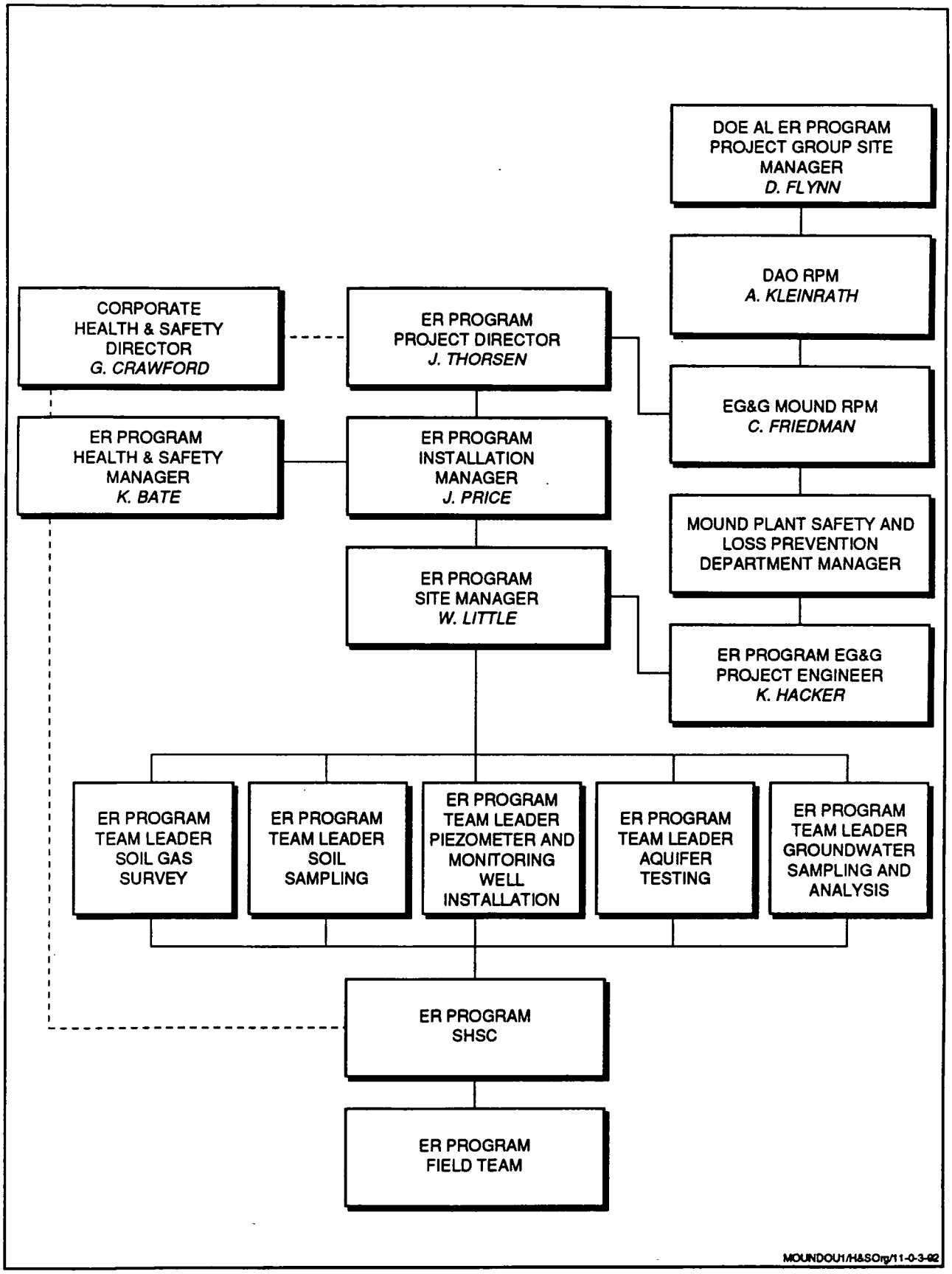

Figure 3.1. Organization of Health and Safety responsibilities.

3.2.3. ER Program Subcontractor Site Manager

The ER Program Subcontractor Site Manager is responsible for the following:

- reading, concurring with, and complying with this HASP, and
- ensuring day-to-day compliance with the health and safety procedures set forth in this plan.

3.2.4. ER Program Subcontractor SHSC

The ER Program Subcontractor SHSC is responsible for:

- reading, concurring with, complying with, and enforcing this HASP;
- modifying this HASP, if necessary, to ensure that it addresses changing conditions or activities onsite;
- performing site-specific health and safety briefings for site workers before the commencement of field activities;
- coordinating initial inspections for all onsite safety equipment;
- informing the Project Manager and Site Manager of potential health and safety hazards;
- coordinating the monitoring of contaminants to determine the degree of hazard present;
- taking control in the event of an emergency situation until Mound Plant personnel arrive;
- ensuring that all personnel have been trained in the appropriate safety procedures, that they have read and understood this HASP, and that these requirements are followed during site activities;
- conducting daily health and safety briefings for field team members;
- requiring that field work be terminated if unsafe conditions develop or an imminent hazard is perceived; and
- ensuring that all required health and safety documentation is completed and maintained in appropriate files.

3.2.5. Field Investigation Team

Each Field Investigation Team member is ultimately responsible for his or her own safety. It is each team member's responsibility to point out any unsafe conditions. They will read, understand, concur with, and comply with the requirements set forth in this plan. No team member will knowingly perform any task under unsafe conditions.

4. RISK/HAZARD ANALYSIS

4.1. IDENTIFICATION AND ASSESSMENT OF POTENTIAL HAZARDS

The SHSC will coordinate the monitoring of potential exposure of field personnel to physical, chemical, radiological hazards, and biological hazards described in this plan. Measurement data will be recorded on appropriate Mound Plant ER Program SOP forms (DOE 1991; DOE 1992). Applicable SOPs are listed in Table IV.1 and are included in Appendix B. A supply of the appropriate forms will be kept at the work site by the SHSC. Completed forms will be filed in the ER Program subcontractor document control files. Copies of these completed forms will be transmitted to Mound Plant.

4.1.1. Physical Hazards

Physical hazards possible during remedial investigations at Mound Plant include frostbite hazards in the winter, heat stress hazards in the summer, flammable or combustible materials hazards, weather-related hazards, lifting, cuts and bruises of the hand, drilling equipment hazards, slip and fall hazards, and utility hazards.

Tornadoes are possible at Mound Plant during spring, summer, and fall field operations. Prior to beginning field operations, training will be obtained from Mound Plant as to their procedures. In addition, the Mound indoctrination pamphlet will be consulted for the appropriate signal for tornadoes. This pamphlet is posted in the office trailer and a copy will be kept by the site health and safety coordinator at each work location.

Thunderstorms are also a likely possibility during field activities. If lightning is spotted nearby by field personnel, all operations will cease until such time as the site health and safety coordinator has declared the area safe to reenter. For additional information on these procedures see subsection 12.2.

Lifting of heavy objects is required of personnel from time to time. Personnel are encouraged to obtain the aid of other field team members when lifting objects. Personnel are to use proper lifting techniques when lifting any object, placing their legs on two sides of a corner and keeping the back straight, using their legs to lift the object. For the Heavy Manual Lifting/Moving Operating Practice (FLD10) see Appendix B.

Cuts and bruises are possible with most of the work being performed at Mound Plant. WESTON has implemented a personnel protection program which addresses the use of gloves for protection.

Table IV.1. Mound Plant ER Program SOPs Applicable to Operable Unit 1

SOP Number	Revision Number	Title
1.1	2	General Instructions for Field Personnel
1.3	1	Sample Control and Documentation
1.4	2	Sample Containers and Preservation
1.5	1	Guide to the Handling, Packaging, and Shipping of Samples
1.6	2	General Equipment Decontamination
1.7	1	Sampling for Removable Alpha Contamination
1.8	1	Personnel Decontamination - Level D Protection
1.9	1	Personnel Decontamination - Level C Protection
1.10	0	Personnel Decontamination - Level B Protection
1.12	0	Air Particulate Sampling with a Real-Time Aerosol Monitor
1.15	1	Guide to Waste Management (currently under review)
2.1	1	Presample Purging of Wells
2.2	2	Field Measurements on Ground and Surface Water Samples
2.3	3	Sampling Monitoring Wells with a Bladder Pump
2.4	1	Sampling Monitoring Wells with a Bucket-Type Bailer
2.7	1	Sampling Commercial/Municipal/Domestic Wells
2.8	0	Sampling for Volatile Organics
3.1	1	Water Level Measurement
3.3	0	Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells
3.4	0	Aquifer Pumping Test
4.1	2	Soil Boring
4.1.1	0	Methods to Control Communications of Subsurface Contaminants with Groundwater
4.2	1	Rock Boring
4.3	1	Monitoring Well Installation
4.4	1	Monitoring Well Development
4.7	0	Piezometer Installation
4.8	1	Piezometer Development
5.1	1	Soil and Rock Borehole Logging and Sampling
5.2	3	Soil Sampling with a Spade and Scoop
5.3	2	Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler
5.8	1	Soil Sampling with a Stainless Steel Surface Soil Sampler
6.1	1	Health and Safety Monitoring of Combustible Gas Levels
6.2	1	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.4	1	Total Alpha Surface Contamination Measurements
6.7	0	Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER

Table IV.1. (page 2 of 2)

SOP Number	Revision Number	Title
6.11	1	Beta-Gamma Radiation Measurements
6.15	0	Measurement of Gamma-Ray Fields Using a Sodium Iodide (NaI) Detector
6.16	0	Heat Stress Monitoring

Heat-related hazards are more likely to occur during this field program than cold related hazards. Mound Plant ER Program SOP 6.16 should be used to help prevent heat-related illness. If level C protection becomes necessary, heat stress becomes more if a concern due to the impervious clothing.

Flammable and combustible materials are not as great a concern as site contaminants. However, there is a moderate risk caused by the use of gasoline for compressors that drive the dedicated bladder pumps in the monitoring wells. Gasoline will be stored in OSHA approved safety cans. Combustible materials will be cleared around the sampling locations to prevent the accidental ignition by the combustion engines. If combustibles cannot be removed, they will be wetted down when filling the engines. Engines will be shut off during refueling.

4.1.2. Chemical Hazards

Chemical hazards possible from the contaminants present during investigations of Operable Unit 1 include inhalation, ingestion, or dermal absorption of organic solvents and exposure to toxic materials. Ambient concentrations of these chemicals will probably be negligible in most areas (except directly in Area B) according to the information obtained from Mound Plant records and from past analytical results from existing monitoring wells. Soil gas data showed concentrations of halogenated volatile organics and chlorinated hydrocarbons in the parts per billion range in some areas of the plant, especially in Operable Unit 1, Area B (HGC 1987) (Figure 4.1). Area B contains remnants of a historical landfill suspected of having soils and groundwater contaminated with volatile organic compounds (VOCs). Some of the compounds expected are benzene, chloroethene (vinyl chloride), trichloroethene, tetrachloroethene, 1,2-*trans*-dichloroethene, tetrachloromethane (carbon tetrachloride), trichloromethane (chloroform), and 1,1,1-trichloroethane. Groundwater concentrations for contaminants of concern are provided in Figures 4.2 through 4.6.

A general reference on hazardous materials will be available onsite for review and consultation (NIOSH 1990). Appendix A summarizes the requirements and information in this plan, and pages 4 of 35 through 10 of 35 present the exposure-limits and concentrations of suspected site contaminants immediately dangerous to life and health (CFR 1989; NIOSH 1990; ACGIH 1990). The exposure limit refers to airborne concentrations of substances below which nearly all workers may be exposed for 8 hours per day, 52 weeks per year, without adverse health effects.

4.1.3. Radiological Hazards

Because of past activities at Mound Plant, radiological hazards are associated with many of the potential release sites addressed by the ER Program. Table IV.2 lists the radionuclides associated with

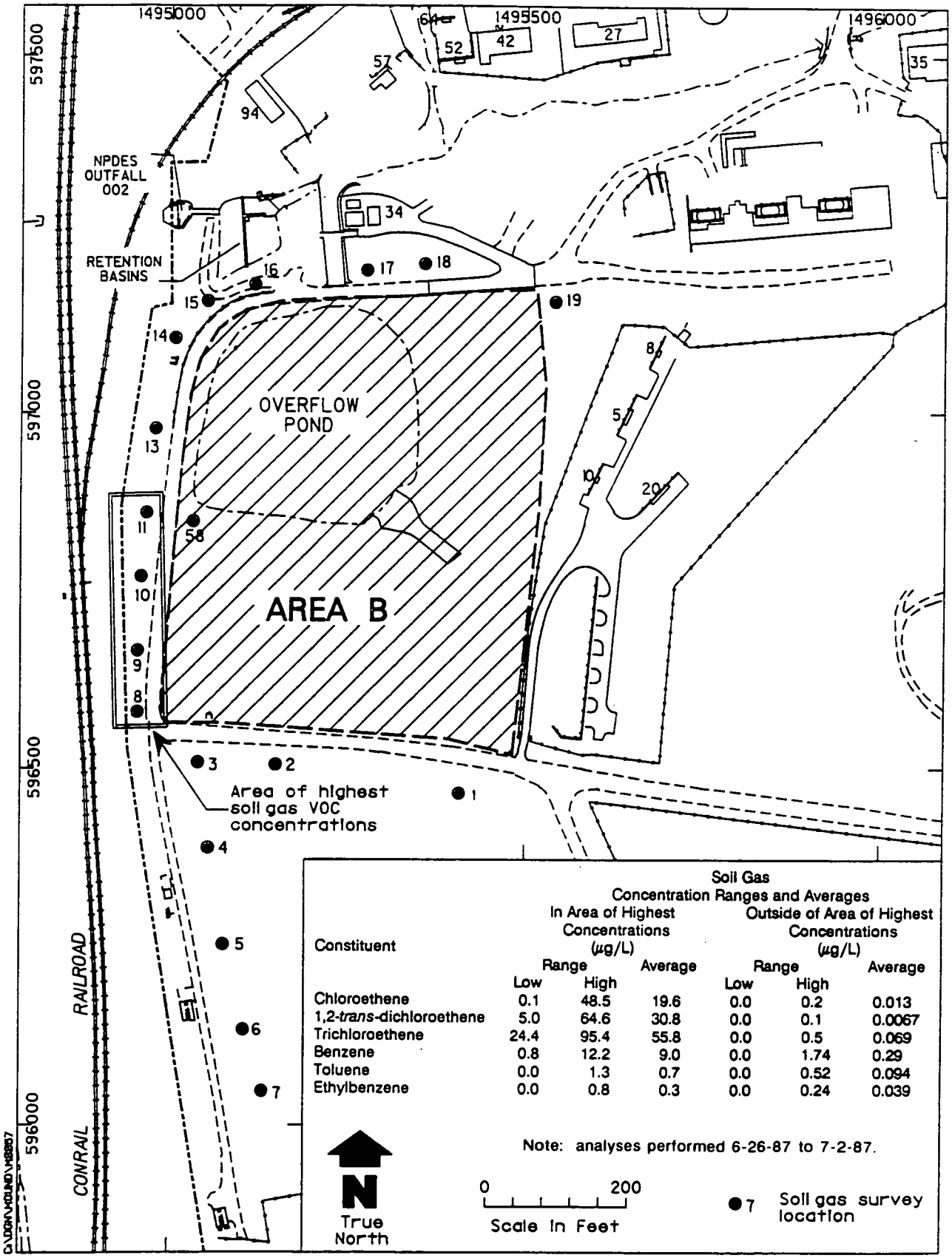

Figure 4.1. Soil gas locations adjacent to Area B.

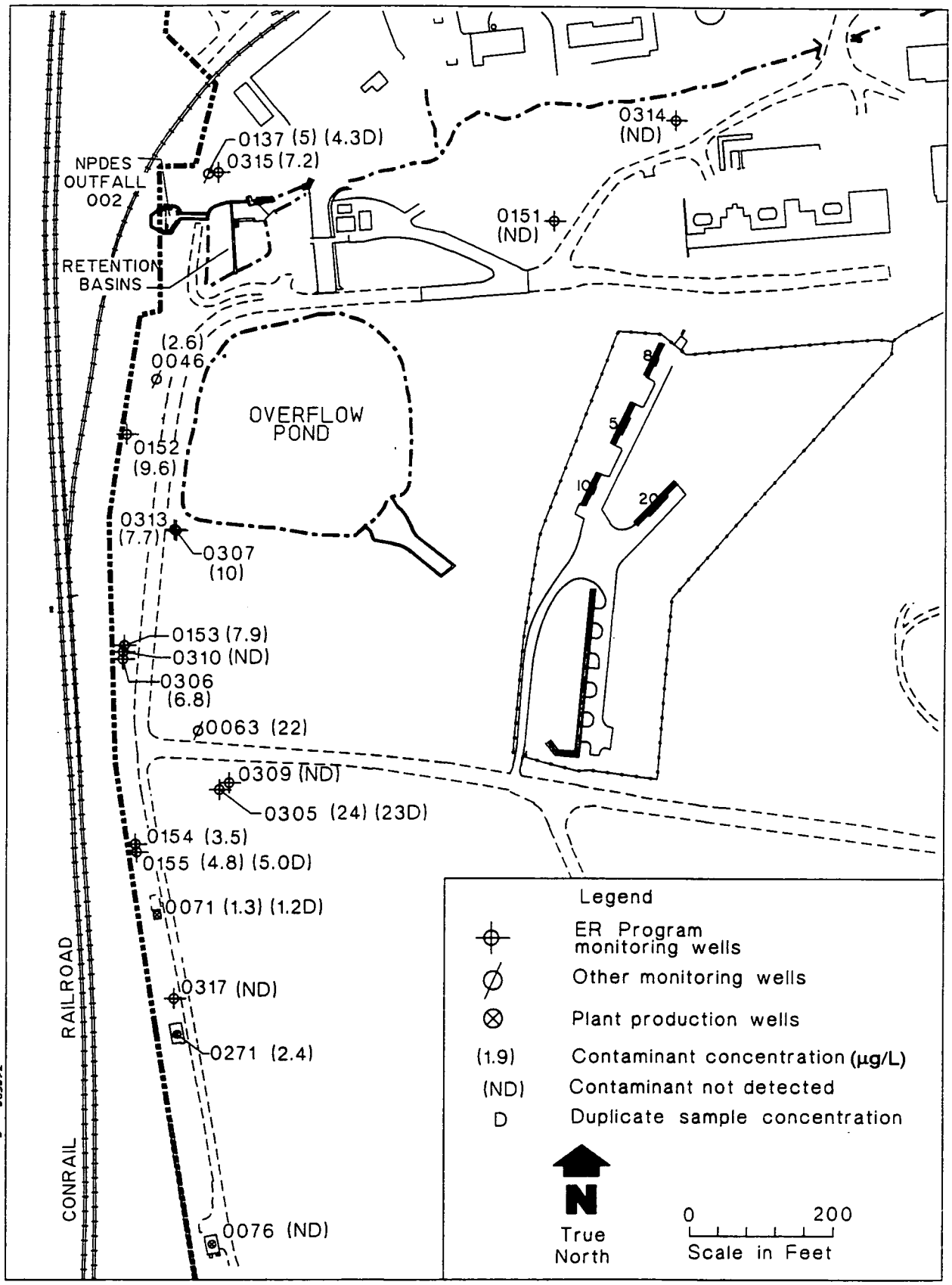

Figure 4.2. Trichloroethene concentrations for Area B wells, December 1991.

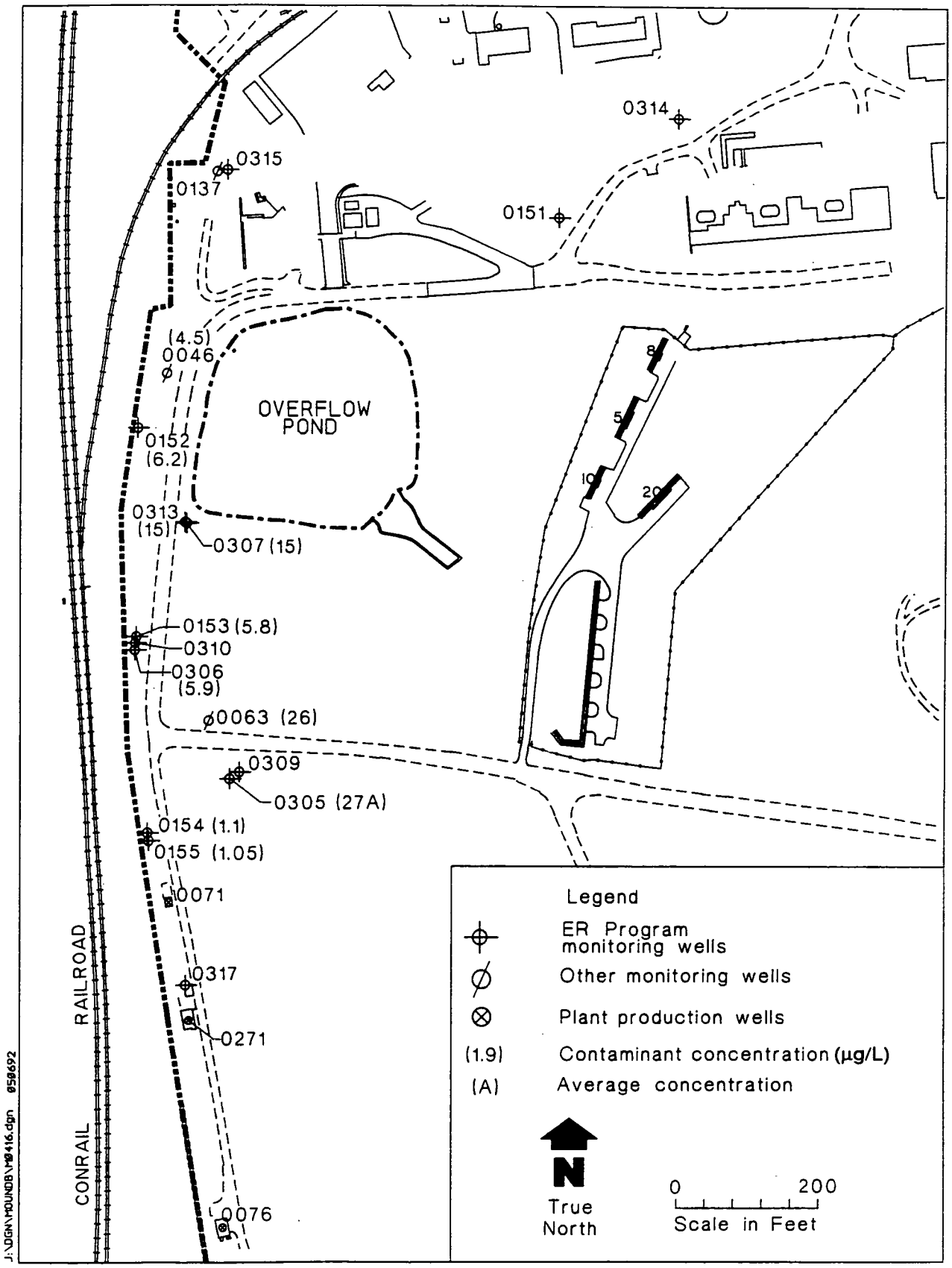

Figure 4.3. Tetrachloroethene concentrations for Area B wells, December 1991.

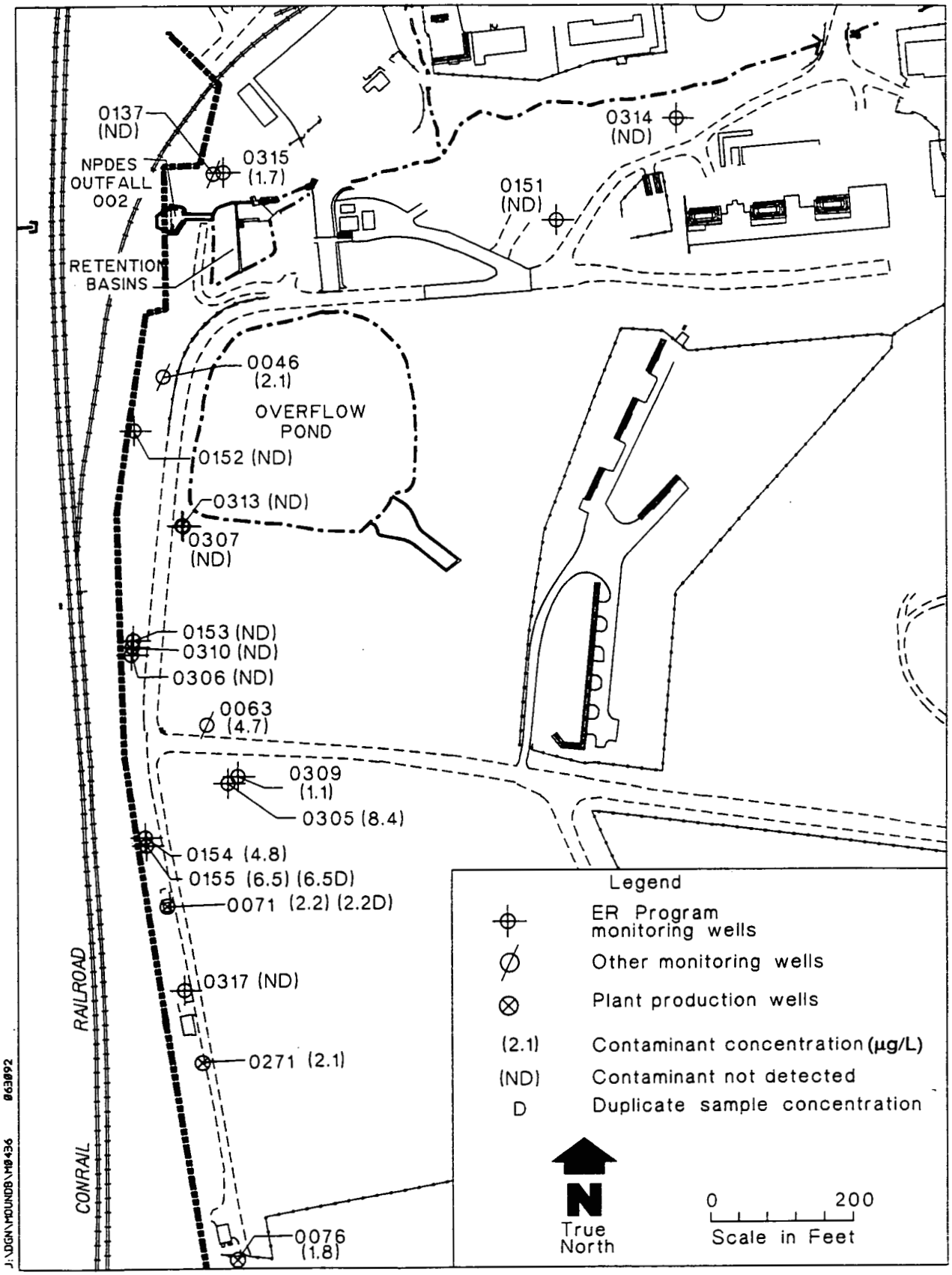

Figure 4.4. 1,2-trans-Dichloroethene concentrations for Area B wells, December 1991.

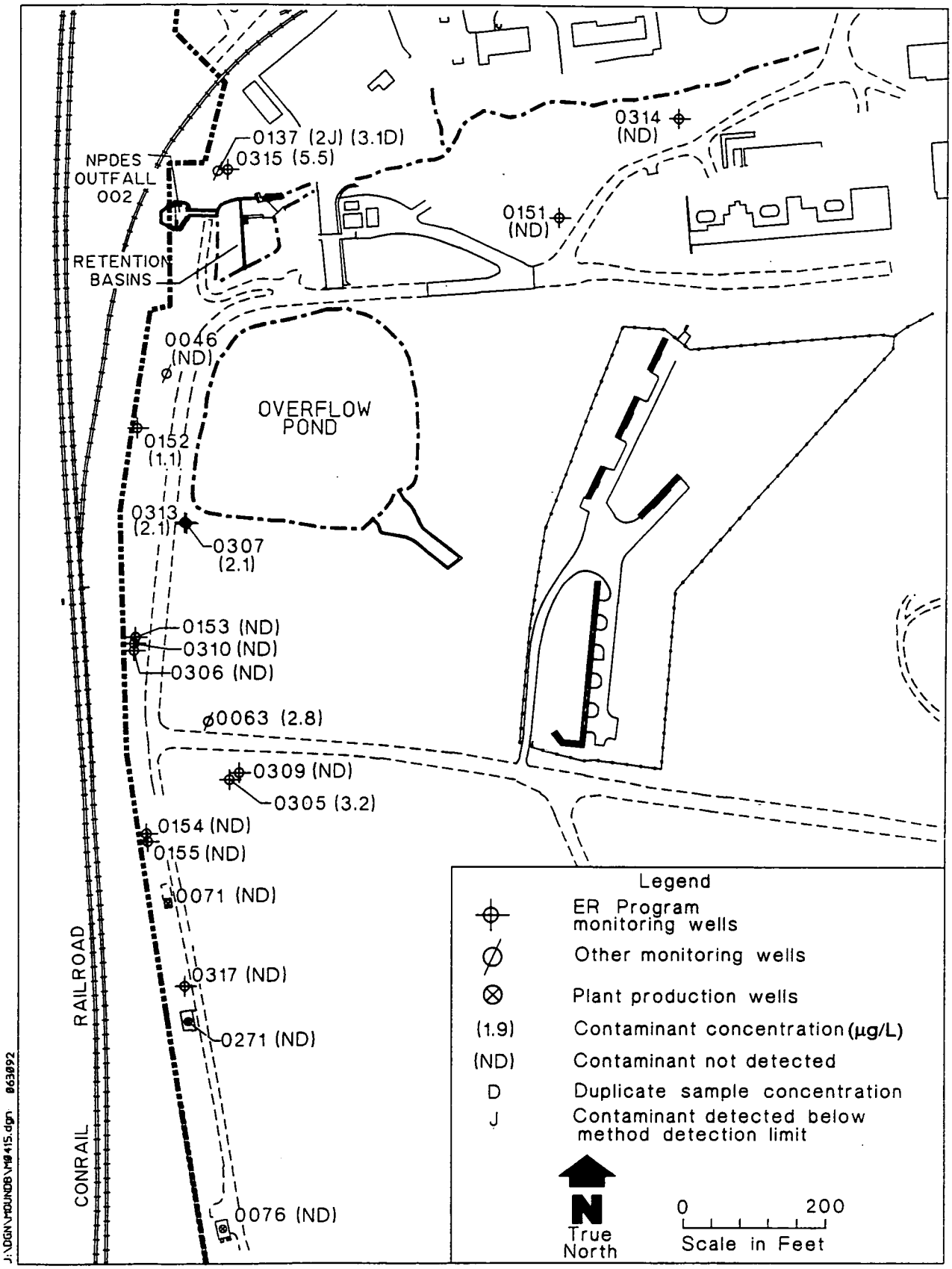

Figure 4.5. Tetrachloromethane concentrations for Area B wells, December 1991.

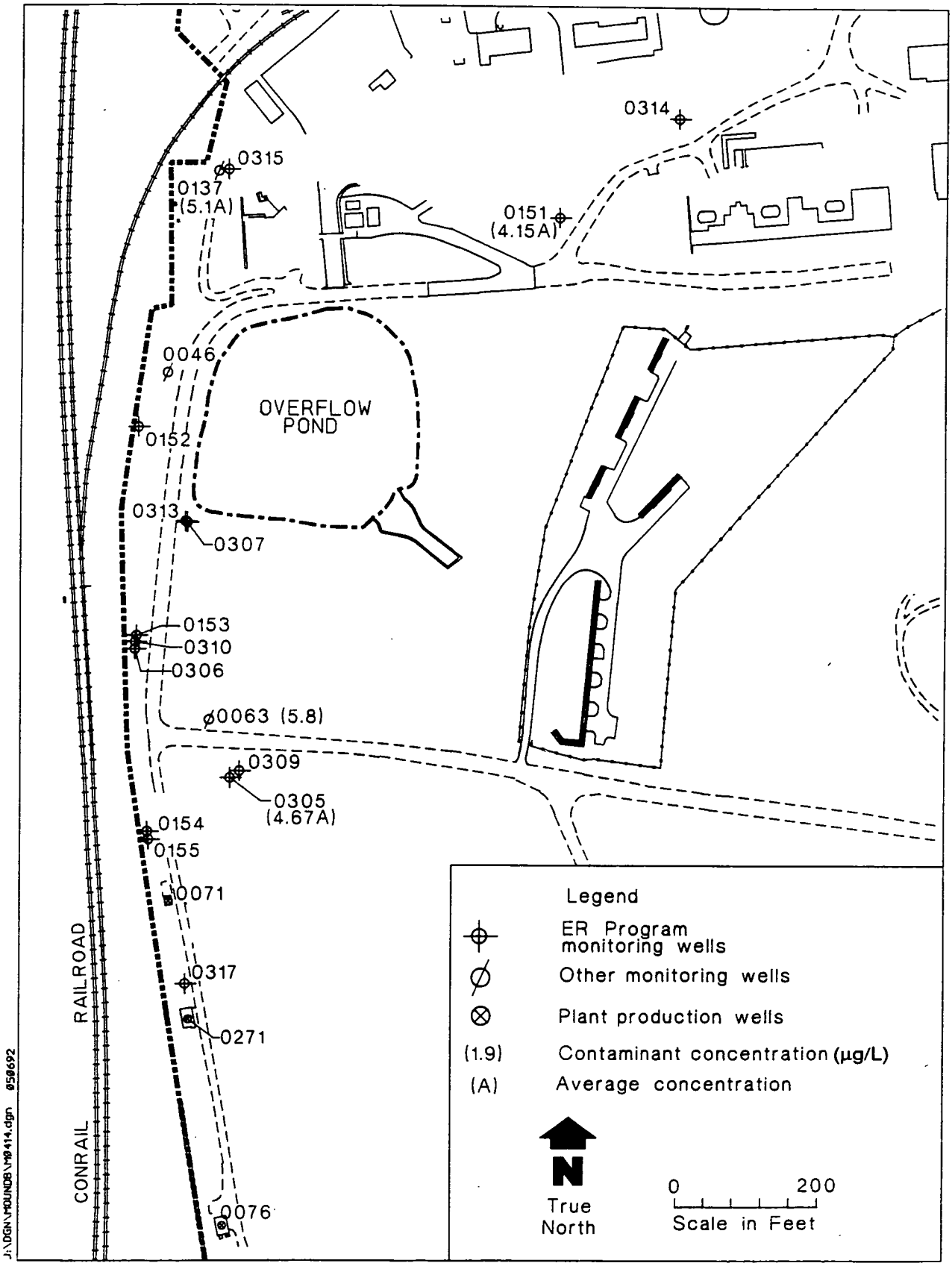

Figure 4.6. Trichloromethene concentrations for Area B wells, December 1991.

Table IV.2. Radiological Hazards of Concern[a,b]

Radionuclide	Major Radiations	Radioactive Half-Life	Inhaled Air Lung Retention Class DAC (μCi/mL) D	W	Y	Monitoring Instrument
Actinium-227	Beta, gamma	21.6y	2.E-13	7.E-13	2.E-12	Pancake GM probe
Americium-241	Alpha, gamma	458y	-[c]	2.E-12	-	MicroR meter
Cesium-137	Beta, gamma	30.0y	7.E-08	-	-	MicroR meter
Cobalt-60	Beta, gamma	5.263y	-	7.E-08	1.E-08	MicroR meter
Curium-244	Alpha, gamma	17.6y	-	4.E-12	-	Alpha scintillometer or gas proportional
Neptunium-237	Alpha, gamma	2.14×10^6y	-	2.E-12	-	Alpha scintillometer or gas proportional
Neptunium-239	Beta, gamma	2.346d	-	1.E-06	-	Alpha scintillometer or gas proportional
Plutonium-238^	Alpha, gamma	86.4y	-	3.E-12	7.E-12	FIDLER, or Alpha scintillometer
Plutonium-239^	Alpha, gamma	24,390y	-	2.E-12	6.E-12	FIDLER, or Alpha scintillometer
Plutonium-240^	Alpha, gamma	6580y	-	2.E-12	6.E-12	FIDLER, or Alpha scintillometer
Plutonium-241^	Beta, gamma	13.2y	-	1.E-10	3.E-10	Pancake GM probe
Plutonium-242^	Alpha, gamma	3.79×10^5y	-	2.E-12	6.E-12	Alpha scintillometer or gas proportional
Polonium-208	Alpha, gamma	2.93y	NL	NL	NL	Alpha scintillometer or gas proportional
Polonium-209	Alpha, gamma	103y	NL	NL	NL	Alpha scintillometer or gas proportional
Polonium-210	Alpha, gamma	138.40d	3.E-10	3.E-10	-	Alpha scintillometer or gas proportional
Protactinium-231	Alpha, gamma	3.25×10^4y	-	7.E-13	2.E-12	Alpha scintillometer or gas proportional
Radium-226	Alpha, gamma	1602y	-	3.E-10	-	Alpha scintillometer or gas proportional
Radon-222	Alpha, gamma	3.8229d	8.E-08[d]	-[d]	-[d]	A field instrument is not needed to detect this radionuclide in outdoor areas
Strontium-90	Beta	27.7y	2.E-09	-	2.E-09	Pancake GM probe
Thorium-228^	Alpha, gamma	1.910y	-	4.E-12	7.E-12	Alpha scintillometer or gas proportional
Thorium-229^	Alpha, gamma	7340y	-	4.E-13	1.E-12	Alpha scintillometer or gas proportional
Thorium-230^	Alpha, gamma	8.0×10^4y	-	3.E-12	7.E-12	Alpha scintillometer or gas proportional
Thorium-232^	Alpha, gamma	1.41×10^{10}y	-	5.E-13	1.E-12	Alpha scintillometer or gas proportional

Table IV.2. (page 2 of 2)

Radionuclide	Major Radiations	Radioactive Half-Life	Inhaled Air Lung Retention Class DAC (μCi/mL) D	W	Y	Monitoring Instrument
Tritium^ (water)*	Beta	12.262y	2.E-05	2.E-05	2.E-05	No field instrument is commonly available to detect this radionuclide
Tritium^ (Elemental)*	Beta	12.262y	5.E-01	5.E-01	5.E-01	No field instrument is commonly available to detect this radionuclide
Uranium-233^	Alpha, gamma	1.62×10^5y	5.E-10	3.E-10	2.E-11	Alpha scintillometer or gas proportional
Uranium-234^	Alpha, gamma	2.47×10^5y	5.E-10	3.E-10	2.E-11	Alpha scintillometer or gas proportional
Uranium-235^	Alpha, gamma	7.1×10^8y	6.E-10	3.E-10	2.E-11	Alpha scintillometer or gas proportional
Uranium-238^	Alpha, gamma	4.51×10^9y	6.E-10	3.E-10	2.E-11	Alpha scintillometer or gas proportional

DAC - Derived Air Concentration. Quantity obtained by dividing the ALI (Annual Limit on Intake) for any given radionuclide by the volume of air breathed by an average worker during a working year (2.4×10^3 m^3).
y - Years.
GM - Geiger Mueller.
d - Days.
FIDLER - Field instrument for the detection of low energy radiation.
NL - Not listed.
[a]USDHEW 1970. "Radiological Health Handbook." U.S. Department of Health, Education, and Welfare, Public Health Service, Food and Drug Administration, Bureau of Radiological Health, Rockville, Maryland. Revised edition, January 1970.
[b]DOE 1989. "Radiation Protection for Occupational Workers." DOE Order 5480.11, December 21, 1988. U.S. Department of Energy, Washington, D.C., Change 1: July, 20, 1989.
[c]A dash indicates no values given for this data category.
[d]These values are appropriate for protection from radon combined with its short-lived daughters and are based on information given in ICRP Publication 32: Limits for Inhalation of Radon Daughters by Workers and Federal Guidance Report No. 11: Limiting Values of Radionuclide Intake and Air Concentrations, and Dose Conversion Factors for Inhalation, Submersion, and Ingestion (EPA 520/1-88-020). The values given are for 100% equilibrium concentration conditions of the radon daughters with the parent. To allow for an actual measured equilibrium concentration or a demonstrated equilibrium concentration, the values given in this table should be multiplied by the ratio (100%/actual %) or (100%/demonstrated %), respectively. Alternatively, the DAC values for radon-222 may be replaced by 1/3 WL*, for appropriate limiting of daughter concentrations. Because of the dosimetric considerations for radon, no f_1 or lung clearance values are listed (DOE 1989).

* A "Working Level" (WL) is any combination of short-lived radon daughters in one liter of air without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3 E+05 MeV of alpha energy (DOE 1989).

*The ICRP identifies tritiated water as having immediate uptake and distribution; therefore no solubility classes are designated. For purposes of this table, the DAC values are shown as being constant, independent of solubility class. For tritiated water, the inhalation DAC values allow for an additional 50% absorption through the skin, as described in ICRP Publication No. 30: Limits for Intakes of Radionuclides by Workers. For elemental tritium, the DAC values are based solely on consideration of the dose-equivalent rate to the tissues of the lung from inhaled tritium gas contained within the lung, without absorption in the tissues (DOE 1989).

^ - radiological contaminants of concern for Area B

the site-wide operable unit. Potentially, though very unlikely, any of these radionuclides could have been accidently disposed of in Area B or migrated through groundwater to Area B. Plutonium is the most common radioactive contaminant at Mound Plant and should be anticipated, at least in low levels, everywhere within Operable Unit 1. Thorium, uranium, and tritium may also be present in Area B.

Tritium may be encountered during Operable Unit 1 activities, but the levels in ground and surface water are below those established in the EPA drinking water standards (Figure 4.7). Those concentrations are not believed to be harmful to field employees. Standard groundwater sampling protective equipment (nitrile gloves) will be sufficient to protect personnel.

Thorium may be found around Area B and may be encountered during the soil gas survey and borehole and piezometer installation. The Mound Plant health physicist, safety manager, and construction survey and monitoring group will be notified before intrusive activities (excavation) begin.

4.1.4. Biological Hazards

Potential biological hazards are listed in Appendix A of this plan and include poison ivy, chiggers, ticks, and mosquitos. Appropriate safety measures will be taken if exposure to biological hazards occurs. The incidence of rabid wild animal bites has increased in the past several years. Although not anticipated at Mound Plant, wild animals are to be avoided, particularly those which display overly passive or aggressive behavior. If wild animals such as these are encountered they should be reported to Mound security.

Lyme disease has increased particularly in the eastern United States. Lyme disease is carried by very small ticks. Ticks are likely to be encountered in high grass and wooded areas. Use of repellents and Tyvek (taped cuffs) in these areas, along with careful inspection while showering, will greatly reduce the risk of contracting Lyme disease. Symptoms of Lyme disease mimic those of less serious illnesses. In the early stages, the symptoms are achy muscles and joints similar to the flu. Often, but not always, there will be a rash at the point of the bite. Later stages involve arthritic effects and even death. The key to the cure is early detection and treatment. If there is a reasonable suspicion of a bite, a blood test will be needed to identify the disease.

No personnel have been identified as being allergic to stings. However, if any personnel visit or work at the site who are known to be allergic to insect stings, they must notify the SHSC and make available their prescribed treatment to first aid trained personnel. All stings and bites should be taken seriously. If stung or bitten, personnel should report the sting or bite and should be observed for severe swelling of the affected area, shortness of breath, nausea, or shock. If these signs and symptoms are noted, personnel should seek immediate medical attention.

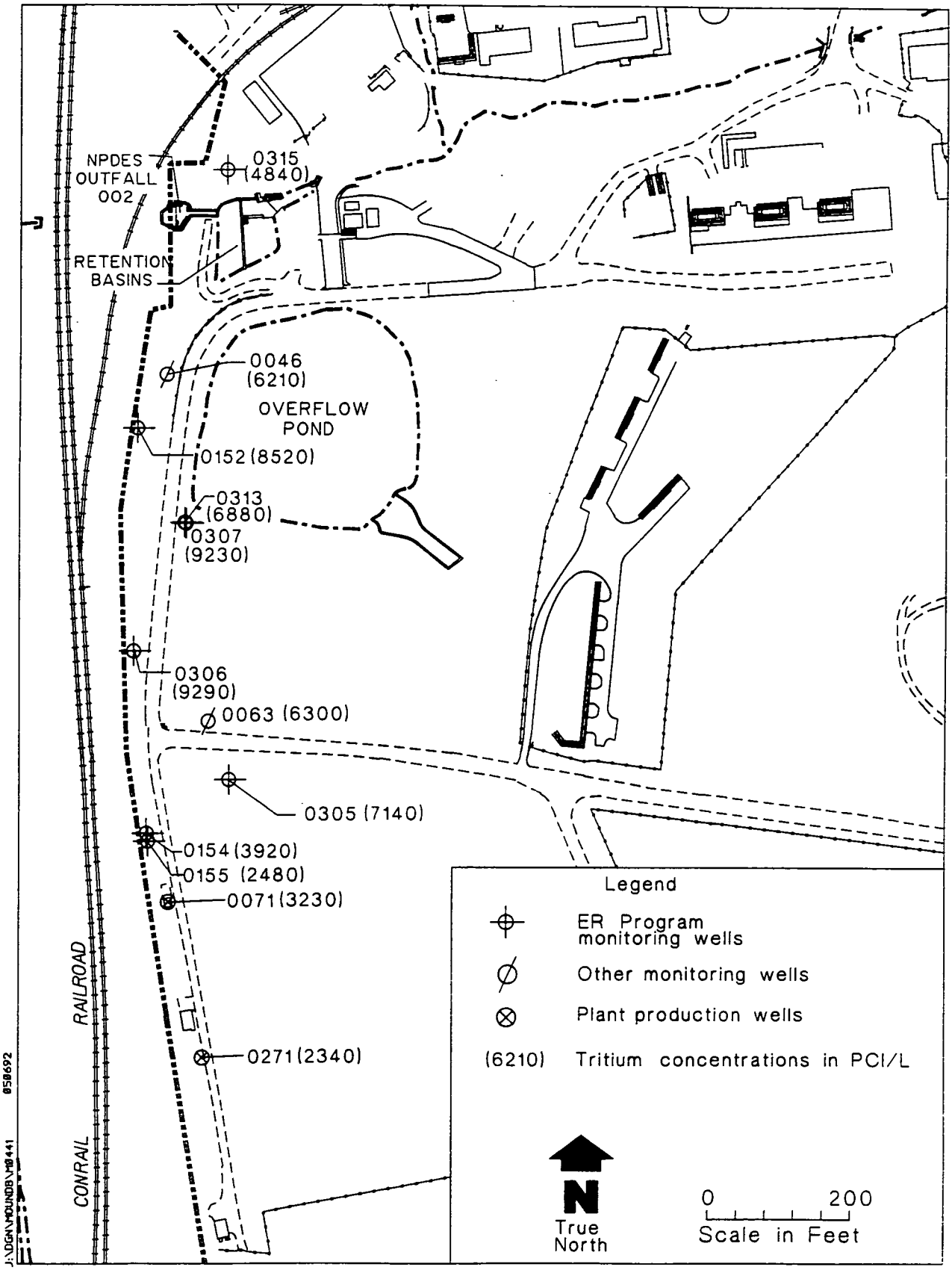

Figure 4.7. Tritium concentrations for Area B wells, August 1991.

4.1.5. Task-By-Task Risk Analysis

The preceding subsections identify the physical, chemical, radiological, and biological hazards known or suspected to be present at Operable Unit 1. This subsection lists each proposed task, identifies which of the hazards apply, and estimates the likelihood of exposure.

TASK 1: Soil Gas Sampling

Likelihood of Exposure: Physical - low to moderate
Chemical - low to moderate
Radiological - low to moderate

Associated Hazards: The soil gas sampling will be conducted in the area of the site sanitary landfill and the historical landfill starting out in Level D protection. These areas are known to have volatile contamination in the groundwater and in the vadose zone. Therefore, exposure to volatiles is likely. Protective clothing will be worn to minimize dermal exposure. Continuous air monitoring will be performed to decrease the likelihood of extended periods of inhalation of organics or radionuclides.

TASK 2: Drilling and sampling of boreholes, and installation of piezometers and monitoring wells

Likelihood of Exposure: Physical - moderate to high
Chemical - low to moderate
Radiological - low to moderate

Associated Hazards: The drilling program will begin in Level D protection. In drilling, there is a great possibility for physical hazards. A drill rig allows for entanglement and pinch points in many parts of the rig. Other injuries may occur from failure of wire rope under extreme stress. If the rope breaks under high tension, it may recoil and can seriously injure workers in the area. Sampling poses a low potential for physical injury. Injuries may result from pinch points or dropped sampling barrels. Drill rigs will be inspected daily by the rig operator and by the Field Team Leader or the SHSC at the drilling site (see Appendix C for drill rig inspection checklist).

Chemical and radiological hazards may occur when drilling disturbs or penetrates a contaminated pocket of soil. The rig will stir some dust and generate heat that may volatilize organics in the soil. These factors combine to enhance the possibility of exposure to field personnel. However, the low concentrations of contaminants expected in the work areas minimize the potential for generation of measurable levels of contaminants (Figures 4.1 through 4.7).

The SHSC will be cognizant of all operations on and near the drill rig and will inform individuals of unsafe working conditions or actions. Continuous air monitoring will be performed to decrease the likelihood of extended periods of organic/radionuclide inhalation. Protective clothing will be worn to minimize dermal exposure.

TASK 3: Overdrilling Existing Boreholes and Installing Surface Casing With a Cable-Tool Drill Rig

Likelihood of Exposure: Physical - moderate to high
Chemical - low to moderate
Radiological - low to moderate

Associated Hazards: The overdrilling and surface casing installation program will begin in Level D protection, unless results from initial borehole drilling indicate a need for additional precautions and protection. In drilling, there is a great possibility for physical hazards. A drill rig allows for entanglement and pinch points in many parts of the rig. Other injuries may occur from failure of wire rope under extreme stress. If the rope breaks under high tension, it may recoil and can seriously injure workers in the area. No samples will be collected in the overdrilled holes. Drill rigs will be inspected daily by the rig operator and by the Field Team Leader or the SHSC at the drilling site (see Appendix C for drill rig inspection checklist).

Chemical and radiological hazards may occur when drilling disturbs or penetrates a contaminated pocket of soil. The rig will stir some dust and generate heat that may volatilize organics in the soil. These factors combine to greatly enhance the possibility of exposure to field personnel. However, the low concentrations of contaminants expected in the work areas minimize the potential for generation of measurable levels of contaminants (Figures 4.1 through 4.7). Because existing borehole are being enlarged during this task, air monitoring will only be performed in the boreholes that had positive instrument readings during installation.

TASK 4: Surface Soil Sampling

Likelihood of Exposure: Physical - low to moderate
Chemical - low to moderate
Radiological - low to moderate

Associated Hazards: The surface soil sampling program will begin in Level D protection. The hazards for hand augering are similar to those of drilling. The potential for contact with chemically or radiologically contaminated soils is enhanced because this operation tends to stir more dust. A powered hand auger may still present the operator with entanglement and pinch point hazards but to

a lesser degree than a drill rig. With a nonpowered hand auger, the probability of physical injury is greatly reduced. Protective clothing will be worn to minimize dermal exposure. Continuous air monitoring will be performed to decrease the likelihood of extended periods of inhalation of organics or radionuclides.

TASK 5: Aquifer Testing

Likelihood of Exposure: Physical - low to moderate
Chemical - low to moderate
Radiological - low to moderate

Associated Hazards: Aquifer testing will be performed in Level D protection. Aquifer testing poses no direct safety concerns; however, time series sampling during the aquifer test may expose the sampler through dermal contact and inhalation to possibly contaminated water for short periods of time. Protective gloves will be used in collecting the water samples to limit dermal contact. The breathing zone will be monitored by combustible gas indicator (CGI) and photoionization detector (PID) instruments to monitor against inhalation of organic concentrations so extended periods of inhalation will not occur.

TASK 6: Decontamination

Likelihood of Exposure: Physical - low to moderate
Chemical - low to moderate
Radiological - low to moderate

Associated Hazards: This task is associated with Tasks 1 through 4. The level of protection in Tasks 1 through 4 will be duplicated for the decontamination phase of a particular task. Exposure limits (action levels) for this investigation are set low to prevent the necessity for Level B protection. However, the potential exists for direct contact with contaminants that may be taken up by dermal absorption. Protective clothing will be worn to minimize dermal exposure. Continuous air monitoring will be performed to decrease the likelihood of extended periods of organic/radionuclide inhalation.

5. WORKER TRAINING

As in all field activities at hazardous waste sites, site personnel must meet certain criteria before entering a potentially hazardous area. The criteria outlined in OSHA regulations (29 CFR 1910.120) (CFR 1990) are

- 40 hours of health and safety indoctrination training,
- 24 hours of supervised on-the-job training,
- participation in an annual medical monitoring program,
- 8 hours of additional training for managers,
- participation in an annual respirator fit-test program, and
- 8 hours of annual refresher training.

Site-specific health and safety training will be conducted and documented for all members of the field team. Information in this plan will be presented to the field team members by the SHSC during a site-specific health and safety training session before the investigations begin. An outline of the site-specific training is provided in Table V.1.

In addition, the Mound health physics orientation required by Mound Procedure 8019 will be conducted by Mound Plant personnel. During field sampling activities, at least two onsite members of the ER Program subcontractor field team will have current Red Cross or equivalent certification in first aid and cardiopulmonary resuscitation.

6. PERSONNEL PROTECTION REQUIREMENTS

Modified Level D protection will be used for Operable Unit 1 investigation activities on the basis of the soil gas data (HGC 1987) and the expectation that little contamination is present. However, if levels of organic vapors approaching 1.0 unit above background, as measured by a PID, are detected in the breathing zone, the site will be evacuated and further action will be reevaluated by the site supervisor and the SHSC, as necessary, to avoid the inhalation of organic or toxic vapors. Soil gas concentrations in the vicinity of Area B are shown on Figure 4.1.

Modified Level D protective equipment will include

- Tyvek or another type of disposable coverall, when dusty or dirty operations are being performed;
- Saranex, when muddy or wet conditions are present;
- Latex gloves;
- steel-toed safety boots;
- disposable boot covers, where appropriate; and
- hard hats, safety glasses, and hearing protection, as needed.

Table V.1. Training Outline

I. Purpose and objectives of training

II. Recognizing and identifying health and safety hazards at Mound Plant Operable Unit 1

A. Physical hazards
- structures
- noise
- equipment
- terrain
- heat
- cold

B. Chemical hazards
- heavy metals
- volatile organics
- flammable materials
- other (polychlorinated biphenyls, asbestos, etc.)

C. Radiological hazards
- internal
- external

D. Biological hazards
- insect
- snake
- plant

E. Potential health effects
- recognition of the signs and symptoms of overexpsoure to the physical hazards of cold or heat
- recognition of the signs and sysmtoms of overexpsorue to site contaminants

III. Safety and monitoring requirements

A. Controlled area restrictions
- eating/drinking/smoking
- access control points

B. Protective equipment requirements
- clothing: hard hats, boots, gloves, coveralls
- respiratory protection

C. Procedures for using protective equipment
- respirator fit-test and use
- impermeable clothing

D. Personnel contamination monitoring and decontamination

IV. Emergency response requirements

A. Getting emergency assistance
B. Emergency notification procedures

V. Communicating information on hazards (right to know)

A. List of hazardous materials
B. Material safety data sheets
- as applicable from the site safety evaluation form (Appendix D)

If needed, Level C protective equipment will include

- full-face, air-purifying, cartridge-equipped (GMC-H) respirators;
- Tyvek or another type of disposable coverall;
- Saranex, when muddy or wet conditions are present;
- Latex inner gloves;
- nitrile outer gloves;
- steel-toed safety boots with disposable latex or polyvinyl chloride boot covers; and
- hard hats and hearing protection, as necessary.

If Level C protection is required, a SHSC qualified to oversee Level C activities will be present during the work. Subcontractors must follow all health and safety requirements given in this HASP and will provide their own protective clothing.

The radionuclide concentrations may exceed background levels during the investigation of Operable Unit 1. Plutonium and thorium represent substantial inhalation hazards, so engineering controls such as dust suppression, and respiratory protection will be used, as necessary, to prevent the inhalation of particulates, especially during drilling or dust-producing activities. Tyvek coveralls and disposable gloves will be worn as required. In wet areas, Saranex coveralls and overboots or hip waders will be worn. All protective clothing will remain at the work site or will be decontaminated before removal from the immediate work area.

When dust levels reach 5 mg/m^3, radioactive particulates may approach levels of concern if soil concentrations of plutonium-238 or thorium-230 are greatly elevated. Therefore, at 5 mg/m^3 on the real-time aerosol monitor (RAM), the level of protection will be upgraded to Level C, and an air sampling program will be implemented. A downgrade to Level D can occur only when air sampling results indicate that airborne radioactive particulate levels are below a third of the most restrictive DAC (plutonium-238, thorium-230), 1XE-12, μCi/mL. Air sampling to allow downgrading will require the collection of air particles on a filter and gross alpha analysis using a portable alpha sample counter.

The levels of protection will be based on the following total organic concentration levels for a 1-minute sustained reading in the breathing zone, as measured with the PID, flame ionization detector (FID), Draeger tubes, and the RAM.

Protection Level	Concentration Range
Level D	Background - 5 units above background on PID if benzene or chloroethene are not present, or present at concentrations below 1.0 ppm above background.
Level C	5-50 units above background on PID if benzene or chloroethene are not present, or present at concentrations below 1.0 ppm above background. 5 mg/m^3 dust levels. ≥ 1/3 DAC on the air filters.
Exit site; reevaluate condition with the site health and safety officer.	> 1 unit above background on PID if benzene or chloroethene are present at concentrations greater than 1.0 ppm > 20% lower explosive limit on the combustible gas indicator (CGI) > 10 times the DAC on air filters > 3 times background or 1 mR/h > 5 units above background on PID or FID

6.1. JUSTIFICATION FOR PROPOSED LEVELS OF PROTECTION

The concentration ranges for each level of protection prescribed in this document are applicable to the Mound Plant Area B. The proposed concentration ranges are for Levels D and C protection and are supported by the following information.

- The most restrictive numerical exposure limit value of the known volatile contaminants is 1 ppm for chloroethene and benzene (NIOSH 1990).

- The lower detection limit of a photoionization detector is also approximately 0.1 unit. The actual value is dependent upon the substance(s) detected and their ionization potentials. The Occupational Safety and Health Administration ceiling concentration is 5 ppm of chloroethene for a 15-minute period. This ceiling concentration is not to be exceeded without adequate protection.

- Because of chloroethene's chemical properties, air-purifying cartridges do not provide sufficient protection because of rapid breakthrough. In addition, the odor threshold of benzene is greater than the exposure limit, which also prevents the use of air-purifying cartridges as protection.

- Benzene and chloroethene, the most restrictive exposure limit contaminants, have ionization potentials and relative responses that allow detection by photoionization with an 10.2eV lamp.

- Air-purifying respirators (GMC-H cartridges) will provide respiratory protection if dust levels are elevated or airborne radioactive contamination is present.

If concentrations of benzene or chloroethene are present at concentrations greater than 1 ppm above background, work will stop. This HASP will be revised, and appropriate equipment and Level B-trained personnel will be mobilized to the site.

Surveys will be performed with a photoionization detector that has a 10.2eV lamp to confirm levels of organic contaminants at all work locations. Detector tube measurements will be taken for chloroethene and benzene if photoionization detector readings reach 1 unit above background in the breathing zone. Measurements will be performed according to SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector (DOE 1991; DOE 1992), and recorded in the field logbook and on the appropriate SOP forms. The level of protection will be documented in the field logbook.

6.2. PROTECTIVE EQUIPMENT

Emergency equipment, such as fire extinguishers, first aid kits, blankets, and eye wash kits, will be available for immediate response and treatment. Emergency equipment will be clearly marked and the locations pointed out during the health and safety training described in Table V.1 of Section 5.

7. MEDICAL SURVEILLANCE

OSHA requires medical surveillance for "employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances without regard to the use of respirators, for 30 days or more a year." (29 CFR 1910.120, paragraph f) (CFR 1990)

This medical surveillance must include

- baseline medical examination, which includes an evaluation of fitness to wear a respirator and identification of any preexisting conditions that would prevent work with hazardous substances;
- periodic examination (required yearly);
- successful completion of a respirator fit-test;
- examination upon termination of employment; and
- examinations when incidents or exposures occur.

All personnel participating in field activities under the ER Program must show proof of participation in a medical monitoring program that complies with OSHA requirements and proof that they are trained

to work with hazardous substances. Documentation copies must be provided to the SHSC before field activities begin and will be kept on file at the site until activities are completed.

Additional medical monitoring of all field team members will be performed as required by EG&G Mound Plant when work is to be performed at radioactively contaminated areas. This will include baseline whole-body counts and quantitative respirator fit-testing to be performed onsite by Mound Plant staff, urinalysis before work begins, and whole-body counts and/or urinalysis after work is completed. In addition, Mound Plant procedures require that personal protective equipment (including respirators) is provided by Mound for work performed in radioactively contaminated areas. These procedures will quantify and document internal exposures to selected radionuclides from Table IV.2.

8. FREQUENCY AND TYPES OF MONITORING

The concentration ranges for each level of protection prescribed in this document are generally applicable to Mound Plant. The proposed concentration ranges for Levels D and C protection are supported by the following information:

- The most restrictive numerical value of the exposure limits for VOCs is 1 ppm due to possible exposure to chloroethene and benzene (NIOSH 1990).
- The lower detection limit of a PID is approximately 0.1 unit, depending on the chemical being detected.
- Benzene and chloroethene, the most restrictive exposure limit contaminants, have ionization potentials and relative responses that allow detection by photoionization with a 10.2-eV lamp.
- Air-purifying respirators equipped with cartridges capable of removing dusts, mists, and radionuclides will provide respiratory protection if dust levels are elevated or airborne radioactive contamination is present. Level C may not be used to protect against exposure to benzene or chloroethene.
- High concentrations of radioactive contamination in soils, in the range of 600 pCi/g, could result in airborne concentrations that exceed the DAC for thorium or plutonium, if 5 mg/m^3 of respirable dust (<10 microns) are generated. This is verified by the following calculation:

$$3 \times 10^{-12}\ \mu\text{Ci/mL} \times 10^{6}\ \text{pCi}/\mu\text{Ci} \times 10^{6}\ \text{mL/m}^3/(5\ \text{mg/m}^3 \times 10^{-3}\ \text{g/mg}) = 600\ \text{pCi/g},$$

where: DAC for plutonium-238 and thorium-230 = 3×10^{-12} μCi/mL; and
Limit for particulates in air = 5 mg/m^3.

As a minimum, the following instruments will be used during all activities (except aquifer testing) covered in Operable Unit 1 as specified below.

- PID. All work locations, drilling core, and monitoring well head space will be screened using the 10.2-eV probe (Tasks 0, 1, 2, 3, 4, 5).

- RAM. The RAM must be used in Tasks 0, 1, 2, 3, and 4 to determine total dust levels.

- Alpha scintillometer and pancake GM probe. The alpha scintillometer and pancake GM probe must be used to screen work locations and personnel prior to their leaving an area of suspected alpha contamination (Tasks 0, 1, 2, 3, 4, 5, 6).

The following instruments must be added on an activity-specific basis. These are in addition to the baseline instruments identified above.

- CGI. The CGI must be used to detect the presence of combustible gases at areas where any intrusive activity deeper than 5 ft below ground surface takes place or when there is an enclosed space such as the head-space in a monitoring well (Tasks 0, 1, 2, 3, 4, 5). The activities that include intrusive sampling are soil gas monitoring, piezometer and monitoring well installation, and aquifer testing.

- FIDLER and NaI μR meter. Both of these must be used to screen individual work locations when elevated radioactive levels are anticipated or suspected (Tasks 0, 1, 2, 4, 5). The general action level is three times background. Two activities where one of these will be used are the characterization of areas outside the Mound Plant boundary (low level) and at the NPDES survey.

- Air sampling pumps and filters. Medium volume (80 L/m) portable air samplers are to be used when the RAM exceeds 5 mg/m^3 or when airborne alpha contamination is expected (Tasks 0, 1, 2, 3, 4, 5). A portable gross alpha counter will be used to analyze the glass fiber acetate filters.

- Draeger tubes. These tubes are to be used to confirm the presence or absence of benzene or chloroethene (Tasks 0, 1, 2, 3, 4).

Each work location will be surveyed with the appropriate instruments before sampling begins and while sampling continues. These surveys will use a PID that has a 10.2-eV lamp to confirm levels of organic contaminants. PID measurements will be taken periodically in the breathing zone during all remedial investigation activities to document the levels of VOCs and to confirm the level of protection. During drilling, monitoring will be performed after every drilling increment, with a maximum of 10 ft between PID readings. PID measurements will be performed according to SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector (Rev. 0) (DOE 1991; DOE 1992), and recorded on the appropriate SOP forms. The level of protection will be documented in the field logbook. At the completion of each field investigation, these forms will be filed at the office of the contractor performing the work. Copies will be transmitted to Mound Plant.

Field team members will be monitored or surveyed for radioactive contamination after removal of protective clothing and decontamination at the point of exit from the decontamination zone (just before entry into the clean zone).

In addition to organic vapor monitoring, several types of radiation monitoring/screening will be performed during the remedial investigation/feasibility study activities at Mound Plant, Operable Unit 1. The types of instruments used and their frequency of use are as follows:

- Personnel and equipment will be monitored every time a member of the field team leaves a potentially contaminated area or every time potentially contaminated equipment is removed from a work area. In addition, Mound Plant requires final monitoring of all equipment prior to removal from the plant boundary at the end of a job.

- Each general work area will be screened with a FIDLER and a μR meter before work begins to identify any widespread radioactive contamination sources or hazards. If unexpected contamination is detected, no work will begin until the situation is discussed with a health physicist and Mound Plant representatives and until the probable source is identified.

- FIDLER screening will be performed during all intrusive activities (soil sampling, drilling, and conducting soil gas surveys). Samples, drill cuttings, and newly exposed soil will be screened as necessary.

- Air sampling and filter analysis will also be performed when potential dust-producing activities are performed and contamination is known to be present (as evidenced by past data or by screening of work areas, samples, or cuttings). When air monitoring is performed, the pumps with filter(s) attached will be placed at the worst-case exposure (on the drill rig or backhoe) and operated for 4 to 6 hours. The filters will be analyzed (counted) each night.

- Every member of the field team will wear a thermoluminescent dosimeter during all field activities. Thermoluminescent dosimeters can record external exposures from gamma and beta radiation.

- When intrusive work is performed in areas with the potential for removable radioactive contamination, bioassay samples will be taken before the work begins and at the completion of the task. These samples will be analyzed for the radionuclides of concern, typically plutonium-238, to document any internal exposures that have occurred. Additional analytes such as tritium may be added as necessary. Small releases of tritium do occur and may result in slightly elevated tritium levels in bioassay samples.

- Mound Plant may require analysis of 24-hour urine samples before work begins in areas with the potential for radioactive contamination and exit counts when the work is completed. This 24-hour urinalysis documents baseline and exit internal radiation, as well as tritium levels.

The decision to upgrade personal protection levels based on radiation levels can be the result of several occurrences, which are listed below. The decision is based on a combination of data types or observations, and is made by the health physicist or SHSC.

- The radionuclide concentrations in the air (as measured and calculated using air sampling and filter analysis) exceed one-third of the DAC. The problem with applying this action level is that the air sampling is not real time. Results are not available until filters are counted that evening. This sampling is more useful as a way of documenting conditions in the work area.

- Significant levels of radioactive contamination are found during screening of samples, drill cuttings, or work areas, and an activity is being performed that may produce dust.
- RAM readings in excess of 5 mg/m^3.
- Concentrations of organic vapors in excess of 5 ppm (excluding benzene or chloroethene).

Equipment and personnel will be screened for radioactive contamination before release from the site and periodically during field work using an alpha scintillometer to detect alpha-emitting radionuclides such as plutonium-238, according to Mound Plant ER Program SOP 6.4, Total Alpha Surface Contamination Measurement (Rev. 0) (DOE 1991); and a Pancake GM probe to detect beta- and gamma-emitting radionuclides according to Mound Plant ER Program SOP 6.11, Beta-Gamma Radiation Measurements (Rev. 1) (DOE 1992); and the release limits specified in Regulatory Guide 1.86 (NRC 1974) (Table VIII.1). If release limits are not met initially, additional decontamination will be required. Equipment that cannot meet the release limits will be confiscated and disposed of by Mound health physics personnel. Field personnel who are unable to remove contamination below the release limit must report to the Mound Plant health physics group.

A personal air sampler will be used to detect airborne radioactive contamination if dust levels exceed 5 mg/m^3 on the miniram. Air sampling will be performed if site information or past data indicate the possibility of airborne (particulate) contaminant levels. The filter(s) will be counted using an alpha scintillometer. If the radioactivity levels of the filter(s) exceed one-third of the derived air concentration (DOE Order 5480.11), Level C protection will continue to be used.

9. SITE CONTROL MEASURES

Control zones will be established before work begins at contaminated sites to protect employees and the general public from unnecessary exposure to toxic materials and radiation and to prevent the spread of contamination. Figure 9.1 shows a typical layout of the control zones. The control (exclusion) zones will be designated onsite based on the nature, magnitude, and extent of contamination and on the potential for contaminant migration. Decontamination is required for personnel, equipment, and vehicles moving from one zone to another.

Additional control zones may also be established for safety considerations other than contamination, including hard hat, eye protection, and ear protection zones, particularly during the operation of heavy machinery and drilling. During drilling, the control zone will be at least 25 ft or one boom length in diameter.

Table VIII.1. Surface Radioactivity Guides (Regulatory Guide 1.86)

ACCEPTABLE SURFACE CONTAMINATION LEVELS			
Nuclide[a]	Average[b,c]	Maximum[b,d]	Removable[b,e]
Uranium-nat, uranium-235, uranium-238, and associated decay products	5000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1000 dpm α/100 cm^2
Transuranics, radium-226, radium-228, thorium-230, thorium-228, protactinium-231, actinium-227, iodine-125, iodine-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Thorium-nat, thorium-232, strontium-90, radium-223, radium-224, uranium-232, iodine-126, iodine-131, iodine-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except strontium-90 and other noted above.	5000 dpm β-γ/100 cm^2	15,000 dpm β-γ/100 cm^2	1000 dpm β-γ/100 cm^2

Source: NRC 1974

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with a dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally, and the entire surface should be wiped.

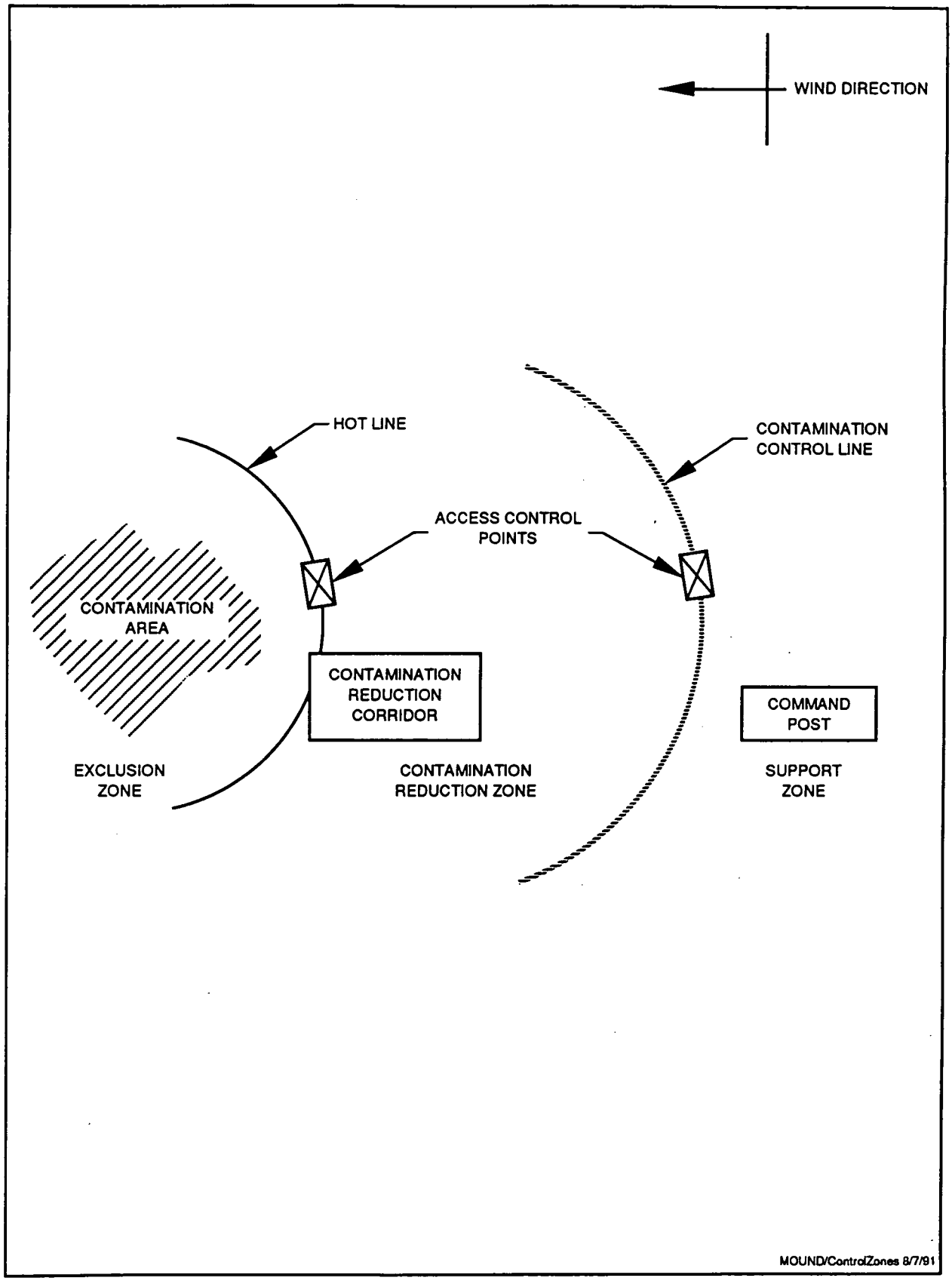

Figure 9.1. Control zones.

Surrounding the exclusion zones is the contamination-reduction zone in which a corridor will be established for final decontamination activities. The size of the contamination-reduction corridor will depend on the number of stations required for decontamination activities and will be determined onsite by the SHSC with the approval of Mound Plant representatives.

For immediate response and treatment, emergency equipment such as fire extinguishers, first aid kits, blankets, and eye wash kits will be available in the contamination reduction zone adjacent to the exclusion zone. Emergency equipment will be clearly marked, and the locations will be pointed out during the health and safety training described in section 5.

Egress from an exclusion zone will normally be allowed only through an access station manned by the SHSC or a designated safety person specifically trained to conduct contamination monitoring. All personnel and equipment leaving the restricted work site or contacting potentially contaminated materials will be monitored and decontaminated, if necessary.

Exclusion zones will be posted with the exclusion criteria, protection requirements, contact person, and other relevant information before field investigations begin.

- Personnel assisting in decontamination activities will wear protective clothing. Protection levels for decontamination workers will be either modified Level D or modified Level C.
- A personnel contamination log will be maintained by the SHSC to record contamination levels and decontamination measures taken.
- All equipment, personnel, and vehicles used in the exclusion zone will require the same level of decontamination. Reusable clothing and respirators will be sanitized in addition to being decontaminated.
- Audits will be conducted to ensure compliance with decontamination procedures.

Some hazards can be minimized through implementation of specific safety procedures, use of special equipment, training of personnel, and availability of emergency response equipment. The following requirements will be enforced during all field activities at Mound Plant:

- Daily preactivity meetings will be held for all personnel involved in field activities to discuss health and safety concerns related to the planned activities and to refresh personnel on emergency response plans.
- Eating, drinking, smoking, and chewing gum or tobacco are prohibited in any area designated as contaminated. Hands and face must be washed when leaving a contaminated work area and before eating, drinking, smoking, or chewing.

- Workers will shower as soon as possible after field work and if directed to do so by the SHSC.

- Restricted-access zones will be established according to the field activity and level of protection. For drilling activities, access will be controlled within a minimum 25-ft or one boom length in diameter of all equipment. This control zone will be established for safety considerations and contamination control. The actual dimensions of the control zone should include the space required for the safe operation of equipment and any Mound Plant security requirements.

10. DECONTAMINATION PROCEDURES

Personnel and equipment will be decontaminated during all field investigations at Mound Plant according to the following SOPs (DOE 1991; DOE 1992):

- 1.6, General Equipment Decontamination (Rev. 2);
- 1.8, Personnel Decontamination - Level D Protection (Rev. 1); and
- 1.9, Personnel Decontamination - Level C Protection (Rev. 1).

These SOPs are provided in Appendix B.

11. STANDARD OPERATING PROCEDURES

As discussed in section 4, ER Program investigations at Mound Plant will be performed according to established SOPs (DOE 1991; DOE 1992). The health and safety SOPs are provided in Appendix B.

12. CONTINGENCY PLANS

12.1. EMERGENCY CONTACTS

Persons and organizations to contact in case of emergencies at Mound Plant are given in Figure 12.1. This emergency contact form will be posted in prominent locations at the work site. An emergency notification flowchart is given in Figure 12.2. Additional contacts are in Appendix A. In an emergency, contacts and evacuation will be coordinated through the security or health physics escort, who will be carrying a two-way radio. Mound Plant personnel will be contacted to contain and cleanup all spills and releases.

12.2. EVACUATIONS

Evacuations may be required under certain circumstances; for example, fire, explosion, release of toxic or hazardous materials, multiple injuries, tornadoes, thunderstorms, etc. If an evacuation becomes

Site Health and Safety Coordinator--

Name: *Jeff Braswell/John Demelas/* Call: *(513) 866-6884 - OU 1 Trailer*

Michael Garman/Jim Davis *(513) 866-9444 - OU 9 Trailer*

Installation Health and Safety Officer--

Name: *John Lemmings* Call: *(513) 865-3924*

Installation Coordinator--

Name: *Chuck Friedman* Call: *(513) 865-4541*

24-Hour Installation Health/Safety Coordinator-- Call: *Ext. 7111 onsite*

FIRE-- Call: *Ext. 7111 onsite, 911 offsite; coordinate through the security escort.*

AMBULANCE-- Call: *Ext. 7111 onsite, 911 offsite; coordinate through the security escort.*

POISON CENTER-- *National Poison Control Center, (404) 588-4400, or Ext. 7111 onsite.*

SECURITY-- Call: *Ext. 7111 onsite; coordinate through the security escort.*

POLICE-- Call: *Ext. 7111 onsite, 911 offsite; coordinate through the security escort.*

YOU ARE LOCATED AT: *To be discussed at each site.*

THE NEAREST TELEPHONE IS LOCATED AT: *Security escort or health physics escort.*

THE NEAREST EMERGENCY MEDICAL SERVICES ARE LOCATED AT:

Medical services onsite, call Ext. 7111; coordinate through the security escort.

Figure 12.1. Emergency contacts

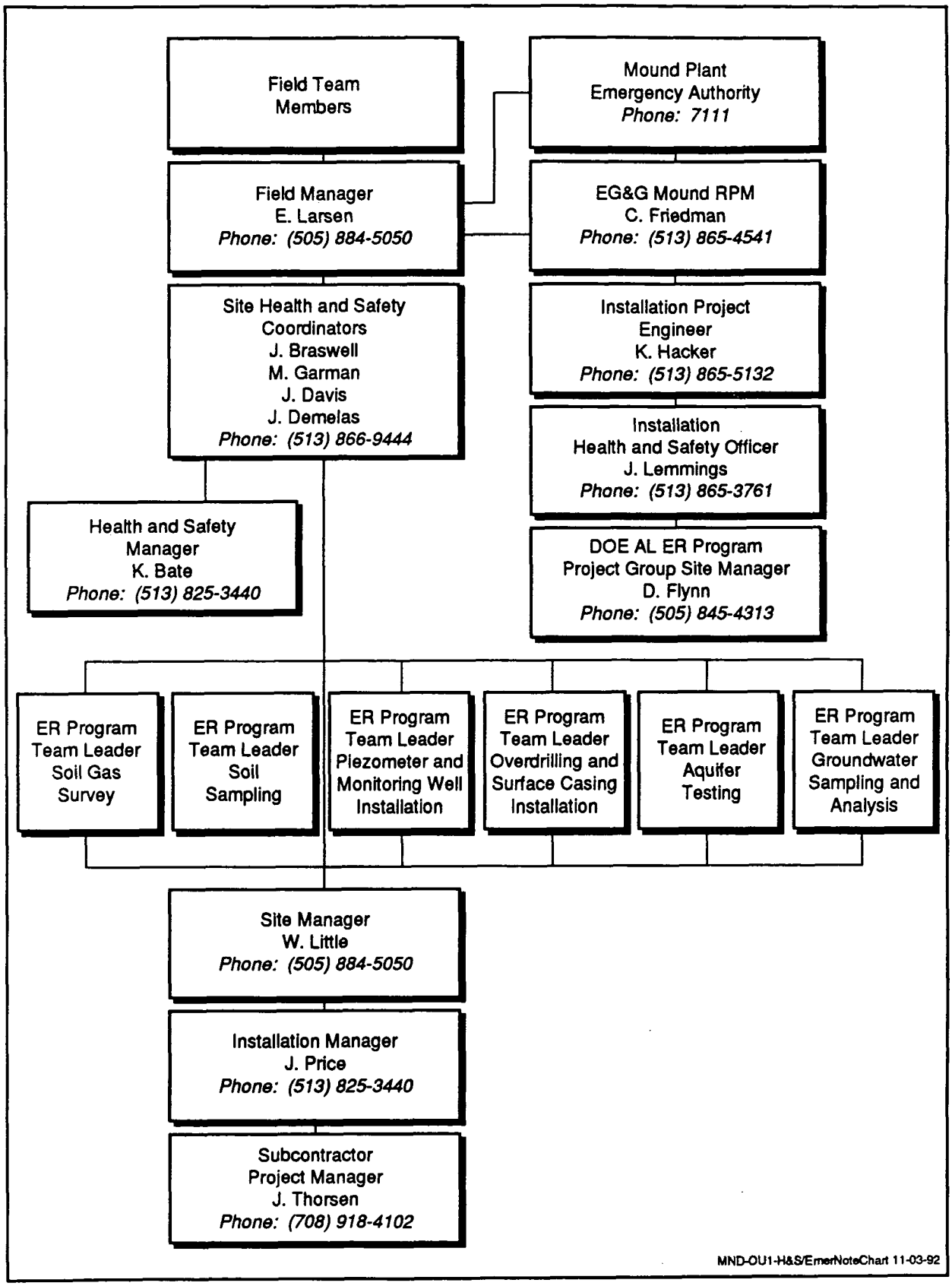

Figure 12.2. Emergency notification flow chart.

necessary, personnel will be alerted by a vehicle horn or a portable air horn. The SHSC will instruct personnel where to meet. For releases of toxic or hazardous materials, it will be upwind of the potential hazard. A head count will be taken, and all applicable emergency procedures will be followed.

12.3. SPILLS

Call 7111. Continue monitoring and arrange with Mound Plant personnel to contain and cleanup spill.

12.4. CONTINGENCY PLANS

Emergency response contingency plans in this subsection will be followed during field investigations. A copy of Appendix A will be available at each work site at all times, and personnel working onsite will be familiar with the HASP and will sign the page at the end of this plan. Evacuation plans and routes will be established on a site-specific basis and discussed with field personnel before field activities begin.

12.4.1. Fire/Explosion

A fire emergency will be handled by evacuating the work area and immediately notifying the Mound Plant fire department (ext. 7111). Only if a fire appears to be small and easily extinguishable will field personnel attempt to put out the fire with available fire extinguishers. The Mound Plant fire department will be notified of any fires. If an explosion occurs, all personnel will be evacuated, and no one will reenter the work area until it has been cleared by the Mound Plant fire department personnel.

12.4.2. Personnel Injuries

In case of minor injuries to personnel, first-aid treatment will be initiated by trained personnel in the field. First-aid treatment is available from Mound Plant paramedics (ext. 7111). In case of serious injuries, the victim will be transported to Sycamore Hospital as soon as possible. Directions to the hospital are given on page 25a (Figure 1) of Appendix A and will be posted with the emergency contact form at prominent locations at the work sites.

Injuries in contaminated areas require additional steps to address possible contamination of the injured person. The SHSC will contact Mound Plant paramedics for injuries in potentially contaminated areas. Responses will vary, depending on the severity of the injury and the extent of contamination, and will be determined initially by the SHSC and later by Mound Plant paramedics.

13. REFERENCES

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DOE. 1989. "Radiation Protection for Occupational Workers." DOE Order 5480.11, December 21, 1988. U.S. Department of Energy, Washington, D.C., Change 1: July 20, 1989.

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EPA. 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA [Interim Final]." Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. October 1988.

HGC. 1987. "Soil Gas Sampling at the DOE Mound Plant in Miamisburg, Ohio." Hydro Geo Chem, Inc. September 1987.

NCRP. 1971. "Basic Radiation Protection Criteria." National Council on Radiation Protection and Measurements. Report No. 39. Bethesda, Maryland.

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USDHEN. 1970. "Radiological Health Handbook." U.S. Department of Health, Education, and Welfare, Public Health Service, Food and Drug Administration, Bureau of Radiological Health, Rockville, Maryland. Revised edition. January 1970.

APPENDIX A

SITE HEALTH AND SAFETY PLAN (HASP) FORMS

SITE HEALTH AND SAFETY PLAN (HASP) FORM

Prepared by: Tom Tharp and Eric Larsen

Date: 06/30/92
W.O. Number: 2744-41-21

Project Identification: O.U. 1 Proposal for Additional Work

Division: ECON
Department/Office: W581/Albuquerque
Site Name: Mound Plant OU1
Client: EG&G
Work Location Address: 1 Mound Road, Miamisburg, Ohio 45343

Site History: (describe briefly)
DOE weapons plant. Volatile contamination stems from historic landfill operations in Area B, Operable Unit 1. Low levels of radionuclide contamination have been seen in the groundwater in the vicinity of Area B. Tritium is present in all alluvial wells in Area B, but at concentrations less than 15 nCi/L.

Scope of Work: (describe briefly) Perform soil gas analyses in suspected source area. Drill boreholes, install piezometers and monitoring wells in the source area and downgradient and upgradient areas, conduct an aquifer test, sample surface soils in and near the source area.

☐ Site visit only; site HASP not necessary. List personnel here and sign off below: N/A

Hazard Assessment and Regulatory Status:

Indicate types of hazards anticipated:

☑ Physio-chemical

Toxic Chemical - Levels

☐ >TLV-TWA ☐ TLV-STEL ☐ >IDLH

☑ Bio-Hazards
☑ Radiation
☑ Physical
☑ Construction type
☐ Industrial type
☑ Nuclear Industry type

Site regulatory status:

CERCLA/SARA
☑ US EPA
☑ State
☑ NPL Site

RCRA
☑ US EPA
☑ State

NRC
☑ 10 CFR 20

OSHA
☑ 1910
☑ 1926
☐ State

Other Federal Agency
☑ DOE
☐ USATHAMA
☐ Air Force

Based on the Hazard Assessment and Regulatory Status, determine the Standard HASP(s) applicable to this project. Indicate below which Standard HASP will be used and append the appropriate pages of this form along with the Standard Plan.

☐ Stack Test
☐ Air Emissions
☐ Asbestos
☐ Industrial Hygiene
☐ Life Systems
☑ Hazardous Material
☐ Construction
☑ NRC/DOE
☐ USATHAMA
☐ Air Force

Review and Approval Documentation:

Reviewed by:
a. P.M. William M. Little — Date: July 20, 1992
b. P.D. Kenneth R. Bahr — Date: July 20, 1992
c. DSO/RSO Mark D. Hansen — Date: July 20, 1992
d. SHSC Eric Larsen — Date: July 20, 1992

Approved by: Robert P. Schoenfelder — Date: 7/22/92

☑ Corporate Health and Safety Director (CHSD)
☐ DSO/RSO (Only with specific delegation by CHSD)

Project start date: July 20, 1992
End date: Unknown

This site HASP must be reissued/reapproved for any activities conducted after December 31, 1992

Amendment date(s):
1. 11/6/92 R. Schoenfelder
2.
3.
4.
5.

M1HSD02.HS1

WESTON Representatives

Organization/Branch	Name/Title	Address	Telephone
ALBUQUERQUE	TOM THARP	6501 Americas Parkway NE Suite 800 Albuquerque, NM 87110	(505) 884-5050
ALBUQUERQUE	ERIC LARSEN	6501 Americas Parkway NE Suite 800 Albuquerque, NM 87110	(505) 884-5050
ALBUQUERQUE	WILLIAM LITTLE	6501 Americas Parkway NE Suite 800 Albuquerque, NM 87110	(505) 884-5050
CINCINNATI	JOHN PRICE	11840-D Kempersprings Dr. Cincinnati, OH 45240-1640	(513) 825-3440

Roles and Responsibilities:

William Little - Site Manager; Eric Larsen - Field Team Leader; Tom Tharp - Field Team Member

WESTON Subcontractors

Organization/Branch	Name/Title	Address	Telephone
Terran Corp.	TBD	P.O. Box 1410 Fairborn, OH	(513) 298-4808
Northstar Drilling	TBD	P.O. Box 355 Little Falls, MN 56345	(612) 632-6552
Bowser and Morner	TBD	4518 Taylorsville Rd. Dayton, Ohio 45424	(513) 236-8805
Hydro Geo Chem	TBD	1430 N. 6th Ave. Tucson, AZ 85705	(602) 623-6981

Roles and Responsibilities: Drilling Contractor: drill boreholes and install piezometers or monitoring wells in specified locations. Assist in sample collection during drilling. Develop the monitoring wells after installation.
Terran: Provide assistance during aquifer testing.
Hydro Geo Chem: Perform soil gas analyses in Area B. Use both GC column and other instrumentation to characterize soil gas in and around site sanitary landfill (SSL).
Bowser Morner, Inc.: Drill pilot boreholes for soil gas program in Area B. Excavate and bench for soil gas program.

Site Specific Health and Safety Personnel

The Site Health and Safety Coordinator (SHSC) for activities to be conducted at this site is: Eric Larsen (WESTON)

The SHSC has total responsibility for ensuring that the provisions of this Site HASP are adequate and implemented in the field.

Changing field conditions may require decisions to be made concerning adequate protection programs. Therefore, the personnel assigned as SHSCs are experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120

Qualifications: C-S/B-T

Designated alternates include: Jeff Slater: B-S certified; Wilma Lombardo: B-S certified; Jeff Braswell: B-S certified; John Demelas: B-S certified; Michael Garman: B-S certified

HEALTH AND SAFETY EVALUATION

Hazard Assessment

Background Review: ☑ Complete ☐ Partial If partial why?

Activities Covered Under This Plan: Soil gas analyses, borehole drilling, piezometer and monitoring well installation, surface soil sampling, aquifer testing, and decontamination of field sampling/drilling equipment.

No.	Task/Subtask	Description	Schedule
1	Soil gas sampling	In and around historic landfill and site sanitary landfill.	July 1992
2	Borehole drilling, piezometer, and monitoring well installation	Drill boreholes, install piezometers and monitoring wells, sample during drilling at specified intervals.	October 1992
3	Borehole overdrilling and surface casing installation	Enlarge existing boreholes by overdrilling and install surface casing with a cable-tool drill rig.	November 1992
4	Surface soil sampling	Collect soil sample in and surrounding Area B.	November 1992
5	Aquifer pumping test	Perform a 30 to 40 monitoring well aquifer pumping test. Will use MW-1 as pumping well.	February 1993
6	Decontamination	Decontaminating sampling equipment.	July-February 1992/93

Types of Hazards:

Numbers refer to one of the following hazard evaluation forms. Complete hazard evaluation forms for each appropriate hazard class.

Physiochemical [1]

- ☑ Flammable
- ☑ Explosive
- ☐ Corrosive
- ☐ Reactive
- ☐ O_2 Rich
- ☐ O_2 Deficient

Chemically Toxic [1]

- ☑ Inhalation
- ☑ Ingestion
- ☑ Contact
- ☑ Absorbtion
- ☑ Carcinogen
- ☐ Mutagen
- ☐ Teratogen
- ☑ OSHA 1910.1000 Substance
- ☑ OSHA Specific Hazard Sub. Standard

Describe:

Radiation [3]

Ionizing:

- ☑ Internal exposure
- ☑ External exposure

Non-ionizing:

- ☐ UV
- ☑ IR
- ☐ RF
- ☐ MicroW
- ☐ Laser

Biological [2]

- ☐ Etiological Agent
- ☑ Other (Plant, insect, animal)

- ☑ **Physical Hazards** [4]
- ☐ **Construction Activities** [5]

Source/Location of Contaminants and Hazardous Substances

Directly Related to Tasks

- ☑ Air
- ☐ Other Surface
- ☑ Groundwater: VOCs, tritium
- ☑ Soil: VOCs, tritium
- ☑ Surface Water: VOCs, tritium
- ☐ Other

Indirectly Related to Tasks - Nearby Process(es) That Could Affect Team Members:

- ☑ Client Facility
- ☑ Nearby Non-client Facility

Describe: Mound Plant: manufactures nuclear weapons components
Offsite areas: combination of residential, farms, varied industry, high traffic areas.

☐ Client Briefing Arranged

HEALTH AND SAFETY EVALUATION – 1 CHEMICAL HAZARDS

☑ N/A Identify and attach Material Safety Data Sheets for all reagent type chemicals, solutions, or other identified materials that in normal use in performing tasks related to this project could produce hazardous substances.

☐ N/A Chemical Contaminants of Concern. If present, provide the following data.

Hazardous Substance/Tasks	Physical Properties	Normal Physical State	State At Site/Proj. Temp.	Characteristics	Incompatible With	Exposure Limits PEL/TLV[a]	Route(s) of Exposure/ Symptoms	Monitoring Instruments/ Ionization Potential + % Response
Tetrachloroethene (Perchlorethene)	☐ Explosive ☐ Flammable ☐ Corrosive ☐ Reactive ☐ Water Reactive ☐ Oxidizer ☐ Radioactive ☐ Other	Liquid	Liquid	pH: Not applicable FP: NA LEL: NA UEL: NA Auto. Ig.: Unknown BP: 250°F MP: Not applicable Sp. Gr.: 1.62 at 68°F Vap. D.: Unknown Vap. P.: 14 mm Hg at 20°C H_2O Sol.: 0.02% at 68°F Other: Noncombustible liquid	Strong oxidizers; chemically active metals such as lithium, beryllium, barium, caustic soda, sodium hydroxide; potash	PEL: Lowest feasible limit to 25 ppm IDLH: 500 ppm carcinogen	☑ Inhalation ☑ Ingestion ☐ Skin Adsorption ☑ Contact ☐ Direct Penetration ☐ Other: Irritation of eyes, nose, and throat, nausea, flushed face/neck, vertigo, dizziness, lack of coordination, headaches, somnolence, skin erythema, liver damage, (carcinogen)	PID 10.2 eV 9.32 eV NA

[a]Use lowest of two, if no TLV/PEL, use Toxicity data in following order: Lowest Toxic Conc. in humans (LTC-HMN); Lowest Lethal Conc. in humans (LLC-HMN); Lowest Toxic Dose in humans (LTD-HMN); Lowest Lethal Dose in humans (LLD-HMN); LC_{50} or LD_{50} in humans; Lowest Toxic Concentration or Lowest Toxic Dose in animals; Lowest LC_{50} or LD_{50} in animals.

HEALTH AND SAFETY EVALUATION — 1 CHEMICAL HAZARDS

☑ N/A Identify and attach Material Safety Data Sheets for all reagent type chemicals, solutions, or other identified materials that in normal use in performing tasks related to this project could produce hazardous substances.

☐ N/A Chemical Contaminants of Concern. If present, provide the following data.

Hazardous Substance/Tasks	Physical Properties	Normal Physical State	State At Site/Proj. Temp.	Characteristics	Incompatible With	Exposure Limits PEL/TLV[a]	Route(s) of Exposure/ Symptoms	Monitoring Instruments/ Ionization Potential + % Response
Chloroethene (vinyl chloride)	☐ Explosive ☑ Flammable (Gas) ☐ Corrosive ☐ Reactive ☐ Water Reactive ☐ Oxidizer ☐ Radioactive ☐ Other	Liquid	Liquid	pH: Not applicable FP: NA (Gas) LEL: 3.6% UEL: 33% Auto. Ig.: 882 °F BP: 7°F MP: Not applicable Sp. Gr.: Unknown Vap. D.: 2.15 Vap. P.: > 1 atm H_2O Sol.: 0.1% at 68°F Other: Flammable gas	Copper, oxidizers, aluminum, peroxides, iron, steel. NOTE: polymerizes in air, sunlight, or heat unless stabilized by inhibitor such as phenol. Attacks iron and steel in presence of moisture.	PEL = 1 ppm carcinogen	☑ Inhalation ☐ Ingestion ☐ Skin Adsorption ☐ Contact ☐ Direct Penetration ☐ Other: weakness; abdominal pain, gastrointestinal bleeding; hepatomegaly; pallor or cyanosis of extremities	PID 10.2 eV 9.99 eV 50%

[a]Use lowest of two, if no TLV/PEL, use Toxicity data in following order: Lowest Toxic Conc. in humans (LTC-HMN); Lowest Lethal Conc. in humans (LLC-HMN); Lowest Toxic Dose in humans (LTD-HMN); Lowest Lethal Dose in humans (LLD-HMN); LC_{50} or LD_{50} in humans; Lowest Toxic Concentration or Lowest Toxic Dose in animals; Lowest LC_{50} or LD_{50} in animals.

HEALTH AND SAFETY EVALUATION — 1 CHEMICAL HAZARDS

☑ N/A Identify and attach Material Safety Data Sheets for all reagent type chemicals, solutions, or other identified materials that in normal use in performing tasks related to this project could produce hazardous substances.

☐ N/A Chemical Contaminants of Concern. If present, provide the following data.

Hazardous Substance/Tasks	Physical Properties	Normal Physical State	State At Site/Proj. Temp.	Characteristics	Incompatible With	Exposure Limits PEL/TLV[a]	Route(s) of Exposure/ Symptoms	Monitoring Instruments/ Ionization Potential + % Response
Trichloroethene	☐ Explosive ☑ Flammable (Class 1C) ☐ Corrosive ☐ Reactive ☐ Water Reactive ☐ Oxidizer ☐ Radioactive ☐ Other	Liquid	Liquid	pH: Not applicable FP: 90°F LEL: 8% UEL: 10.5% Auto. Ig.: 77 °F BP: 189°F MP: Not applicable Sp. Gr.: 1.46 at 68°F Vap. D.: 4.53 Vap. P.: 58 mm Hg at 68°F H_2O Sol.: 0.1% at 68°F Other: Class 1C flammable liquid	Stong caustics and alkalis, chemically-active metals such as barium, lithium, sodium, magnesium, titanium, and beryllium.	PEL = 25 ppm IDLH = 1,000 ppm carcinogen	☑ Inhalation ☑ Ingestion ☐ Skin Adsorption ☑ Contact ☐ Direct Penetration ☐ Other: Headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, irritation of eyes, dermatitis, cardiac arrhythmas, paresthesia. Carcinogen	PID 10.2 eV 9.45 eV 89%

[a]Use lowest of two, if no TLV/PEL, use Toxicity data in following order: Lowest Toxic Conc. in humans (LTC-HMN); Lowest Lethal Conc. in humans (LLC-HMN); Lowest Toxic Dose in humans (LTD-HMN); Lowest Lethal Dose in humans (LLD-HMN); LC_{50} or LD_{50} in humans; Lowest Toxic Concentration or Lowest Toxic Dose in animals; Lowest LC_{50} or LD_{50} in animals.

HEALTH AND SAFETY EVALUATION — 1 CHEMICAL HAZARDS

☑ N/A Identify and attach Material Safety Data Sheets for all reagent type chemicals, solutions, or other identified materials that in normal use in performing tasks related to this project could produce hazardous substances.

☐ N/A Chemical Contaminants of Concern. If present, provide the following data.

Hazardous Substance/Tasks	Physical Properties	Normal Physical State	State At Site/Proj. Temp.	Characteristics	Incompatible With	Exposure Limits PEL/TLV[a]	Route(s) of Exposure/ Symptoms	Monitoring Instruments/ Ionization Potential + % Response
1,2-Dichloroethene	☐ Explosive ☑ Flammable (Class 1B) ☐ Corrosive ☐ Reactive ☐ Water Reactive ☐ Oxidizer ☐ Radioactive ☐ Other	Liquid	Liquid	pH: Not applicable FP: 36°F LEL: 5.6% UEL: 12.8% Auto. Ig.: Unknown BP: 118-140°F MP: Not applicable Sp. Gr.: 1.27 at 77°F Vap. D.: 3.25 Vap. P.: 180-264 mm Hg at 68°F H_2O Sol.: 0.4% at 68°F Other: Class 1B, flammable liquid	Strong alkalies, oxidizers, difluoromethylene dihypofluorite, nitrogen tetraoxide, potassium hydroxide, copper	PEL = 200 ppm IDLH = 4,000 ppm	☑ Inhalation ☑ Ingestion ☐ Skin Adsorption ☑ Contact ☐ Direct Penetration ☐ Other: Irritation eyes, respiratory system, central nervous system, depressant/ depression	PID 10.2 eV Probe 9.65 eV N/A

[a]Use lowest of two, if no TLV/PEL, use Toxicity data in following order: Lowest Toxic Conc. in humans (LTC-HMN); Lowest Lethal Conc. in humans (LLC-HMN); Lowest Toxic Dose in humans (LTD-HMN); Lowest Lethal Dose in humans (LLD-HMN); LC_{50} or LD_{50} in humans; Lowest Toxic Concentration or Lowest Toxic Dose in animals; Lowest LC_{50} or LD_{50} in animals.

HEALTH AND SAFETY EVALUATION — 1 CHEMICAL HAZARDS

☑ N/A Identify and attach Material Safety Data Sheets for all reagent type chemicals, solutions, or other identified materials that in normal use in performing tasks related to this project could produce hazardous substances.

☐ N/A Chemical Contaminants of Concern. If present, provide the following data.

Hazardous Substance/Tasks	Physical Properties	Normal Physical State	State At Site/Proj. Temp.	Characteristics	Incompatible With	Exposure Limits PEL/TLV[a]	Route(s) of Exposure/ Symptoms	Monitoring Instruments/ Ionization Potential + % Response
Benzene	☐ Explosive ☑ Flammable (Class 1B) ☐ Corrosive ☐ Reactive ☐ Water Reactive ☐ Oxidizer ☐ Radioactive ☐ Other	Liquid	Liquid	pH: Not applicable FP: 12°F LEL: 1.3% UEL: 7.9% Auto. Ig.: Unknown BP: 176°F MP: Not applicable Sp. Gr.: 0.88 at 68°F Vap. D.: Unknown Vap. P.: 75 mm Hg at 68°F H_2O Sol.: 0.07% at 68°F Other: Class 1B flammable liquid	Strong oxidizers, many fluorides and perchlorates, nitric acid	PEL = 1 ppm IDLH = 3,000 ppm carcinogen	☑ Inhalation ☑ Ingestion ☑ Skin Adsorption ☑ Contact ☐ Direct Penetration ☐ Other: Irratation eyes, nose, respiratory sytem; giddiness, headache, nausea, staggered gait, fatigue, anorexia, lassitude, dermatitits, bone marrow, depressant/depression , carciongen	PID 10.2 eV Probe 9.24 eV 100% Draeger tubes

[a]Use lowest of two, if no TLV/PEL, use Toxicity data in following order: Lowest Toxic Conc. in humans (LTC-HMN); Lowest Lethal Conc. in humans (LLC-HMN); Lowest Toxic Dose in humans (LTD-HMN); Lowest Lethal Dose in humans (LLD-HMN); LC_{50} or LD_{50} in humans; Lowest Toxic Concentration or Lowest Toxic Dose in animals; Lowest LC_{50} or LD_{50} in animals.

HEALTH AND SAFETY EVALUATION – 1 CHEMICAL HAZARDS

☑ N/A Identify and attach Material Safety Data Sheets for all reagent type chemicals, solutions, or other identified materials that in normal use in performing tasks related to this project could produce hazardous substances.

☐ N/A Chemical Contaminants of Concern. If present, provide the following data.

Hazardous Substance/Tasks	Physical Properties	Normal Physical State	State At Site/Proj. Temp.	Characteristics	Incompatible With	Exposure Limits PEL/TLV[a]	Route(s) of Exposure/ Symptoms	Monitoring Instruments/ Ionization Potential + % Response
Tetrachloromethane (carbon tetrachloride)	☐ Explosive ☐ Flammable ☐ Corrosive ☐ Reactive ☐ Water Reactive ☐ Oxidizer ☐ Radioactive ☐ Other	Liquid	Liquid	pH: Not applicable FP: Not applicable LEL: Not applicable UEL: Not applicable Auto. Ig.: Unknown BP: 170°F MP: Not applicable Sp. Gr.: 1.59 at 68°F Vap. D.: Unknown Vap. P.: 91 mm Hg at 68°F H_2O Sol.: 0.05% at 68°F Other: Noncombustible liquid	Chemically-active metals such as sodium, potassium, magnesium; fluorine, aluminum Note: Forms highly toxic phosgene gas when exposed to flames or welding arcs.	PEL = 2 ppm IDLH = 3,000 ppm carcinogen	☑ Inhalation ☑ Ingestion ☑ Skin Adsorption ☑ Contact ☐ Direct Penetration ☐ Other: Central nervous system depressant; nausea, vomiting; liver, kidney damage; skin irritation.	11.28eV 90% NOTE: PID 10.2eV 11.28eV 0%

[a]Use lowest of two, if no TLV/PEL, use Toxicity data in following order: Lowest Toxic Conc. in humans (LTC-HMN); Lowest Lethal Conc. in humans (LLC-HMN); Lowest Toxic Dose in humans (LTD-HMN); Lowest Lethal Dose in humans (LLD-HMN); LC_{50} or LD_{50} in humans; Lowest Toxic Concentration or Lowest Toxic Dose in animals; Lowest LC_{50} or LD_{50} in animals.

HEALTH AND SAFETY EVALUATION — 1 CHEMICAL HAZARDS

☐ N/A Identify and attach Material Safety Data Sheets for all reagent type chemicals, solutions, or other identified materials that in normal use in performing tasks related to this project could produce hazardous substances.

☐ N/A Chemical Contaminants of Concern. If present, provide the following data.

Hazardous Substance/Tasks	Physical Properties	Normal Physical State	State At Site/Proj. Temp.	Characteristics	Incompatible With	Exposure Limits PEL/TLV[a]	Route(s) of Exposure/ Symptoms	Monitoring Instruments/ Ionization Potential + % Response
1,1,1 Trichloroethane (methyl chloroform)	☐ Explosive ☐ Flammable ☐ Corrosive ☐ Reactive ☐ Water Reactive ☐ Oxidizer ☐ Radioactive ☐ Other	Liquid	Liquid	pH: Not applicable FP: None LEL: 7.5% UEL: 12.5% Auto. Ig.: Unknown BP: 165°F MP: Not applicable Sp. Gr.: 1.34 Vap. D.: Unknown Vap. P.: 100 mm Hg at 20 °C H_2O Sol.: 0.4% Other: Noncombustible liquid; however, the vapor will burn liquid	Stong caustics; strong oxidizers; Chemically active metals such as zinc, aluminum, magnesium powders, salium, and potassium; water NOTE: reacts slowly with water to form hydrochloric acid	PEL = 350 ppm IDLH = 1,000 ppm	☑ Inhalation ☑ Ingestion ☐ Skin Adsorption ☑ Contact ☐ Direct Penetration ☐ Other: Headache, lassitude, central nervous sytem depressant; poor equilibrium; irritation eyes; dermatitus; cardiar arrhythmias	PID 11.7 eV 11.25 IP 90% NOTE: PID 10.2eV 11.25eV 0%

[a]Use lowest of two, if no TLV/PEL, use Toxicity data in following order: Lowest Toxic Conc. in humans (LTC-HMN); Lowest Lethal Conc. in humans (LLC-HMN); Lowest Toxic Dose in humans (LTD-HMN); Lowest Lethal Dose in humans (LLD-HMN); LC_{50} or LD_{50} in humans; Lowest Toxic Concentration or Lowest Toxic Dose in animals; Lowest LC_{50} or LD_{50} in animals.

HEALTH AND SAFETY EVALUATION - 2 BIOLOGICAL HAZARDS OF CONCERN

☑ **Poisonous Plants**

Location/Task No(s).: 1,2,3,4
Route of Source: ☐ Known ☑ Suspect
Exposure: ☐ Inhalation ☐ Ingestion ☑ Contact ☐ Direct Penetration
Team Member(s) Allergic: ☐ Yes ☑ No
Immunization required: ☐ Yes ☑ No

☑ **Insects**

Location/Task No(s).: 1,2,3,4
Route of Source: ☐ Known ☑ Suspect
Exposure: ☐ Inhalation ☐ Ingestion ☑ Contact ☐ Direct Penetration
Team Member(s) Allergic: ☐ Yes ☑ No
Immunization required: ☐ Yes ☑ No

☑ **Snakes, Reptiles**

Location/Task No(s).: 1,2,3,4
Route of Source: ☐ Known ☑ Suspect
Exposure: ☐ Inhalation ☐ Ingestion ☑ Contact ☐ Direct Penetration
Team Member(s) Allergic: ☐ Yes ☑ No
Immunization required: ☐ Yes ☑ No

☑ **Animals**

Location/Task No(s).: 1,2,3,4
Route of Source: ☐ Known ☑ Suspect
Exposure: ☐ Inhalation ☐ Ingestion ☐ Contact ☑ Direct Penetration
Team Member(s) Allergic: ☐ Yes ☑ No
Immunization required: ☐ Yes ☑ No

☐ **Sewage**

Location/Task No(s).:
Route of Source: ☐ Known ☐ Suspect
Exposure: ☐ Inhalation ☐ Ingestion ☐ Contact ☐ Direct Penetration
Team Member(s) Allergic: ☐ Yes ☐ No
Immunization required: ☐ Yes ☐ No

☐ **Etiologic Agents (List)**

Location/Task No(s).:
Route of Source: ☐ Known ☐ Suspect
Exposure: ☐ Inhalation ☐ Ingestion ☐ Contact ☐ Direct Penetration
Team Member(s) Allergic: ☐ Yes ☐ No
Immunization required: ☐ Yes ☐ No

HEALTH AND SAFETY EVALUATION - 3 RADIATION HAZARDS OF CONCERN

Ionizing

			DAC (μCi/L)			
Radionuclide	**Type Emitter**	**Radioactive Half-Life (yrs)**	**D**	**W**	**Y**	**Monitoring Instrument**
Plutonium-238	Alpha, gamma	86.4		3×10^{-12}	7×10^{-12}	FIDLER or Alpha scintillometer
Thorium-230	Alpha gamma	8×10^{4}		3×10^{-12}	7×10^{-12}	Alpha scintillometer or gas proportional
Thorium-232	Alpha, gamma	1.41×10^{10}		5×10^{-13}	1×10^{-12}	Alpha scintillometer or gas proportional
Tritium (water)	Beta	12.262	2×10^{-5}	2×10^{-6}	2×10^{-5}	*No field instrument is commonly available to detect this radionuclide.
Uranium-234	Alpha, gamma	2.47×10^{5}	5×10^{-10}	3×10^{-10}	2×10^{-11}	Alpha scintillometer or gas proportional
Uranium-235	Alpha, gamma	7.1×10^{8}	6×10^{-10}	3×10^{-10}	2×10^{-11}	Alpha scintillometer or gas proportional
Uranium-238	Alpha, gamma	4.51×10^{9}	6×10^{-10}	3×10^{-10}	2×10^{-11}	Alpha scintillometer or gas proportional

DAC - Derived air concentration (DOE draft Order 5480.11); FIDLER - field instrument for the detection of low-energy radiation.

	Location/Source	Task No.(s)	Non-Ionizing Exposure Limits	Protection Protocol Reference
Ultraviolet	Sun	1,2,3,4,5		Sunscreen
Infrared				
Microwave				
Radio frequency				
LASER				

AMENDMENT 3

HEALTH AND SAFETY EVALUATION– 3 RADIATION HAZARDS OF CONCERN

Radionuclide	Type emitter	Ionizing Radioactive Half–Life (Yrs)	DAC (uCi/L) D	W	Y	Monitoring instrument
Cesium–137	Beta, gamma	30	7XE–8	---	---	Gm pancake beta scintillometer

Approval: Robert P. Schoenfelder
Bob Schoenfelder – Corporate Health and Safety

8/14/92
Date

HEALTH AND SAFETY EVALUATION - 4 PHYSICAL HAZARDS OF CONCERN

	Hazard	Task No.(s)	Protection OP(s) Attached
☑	Noise	2,3	90 db - FLD01
☑	Heat - ambient air	1,2,3,4,5	SOP 6.16 FLD02, 05,07
	☐ Hot Process - Steam		
	☐ Hot Process - LT3		
	☐ Hot Process - Incineration		
☑	Cold	1,2,3,4,5	Warm clothing - FLD02,06,07
☑	Rain	1,2,3,4,5	Rain gear FLD 02,07
☑	Snow	1,2,3,4,5	Rain gear FLD 02,07
☑	Electrical Storms	1,2,3,4,5	Take cover FLD02
☐	Confined Space Entry		
☑	"Hot Work"	1,2,3	FLD09
☑	Heavy Manual Lifting/Moving	1,2,3,4	Request assistance FLD10
☑	Rough Terrain	2,3,4	
☑	Housekeeping	1,2,3,4,5	Keep work areas organized
☐	Structural Integrity		
☐	Neighborhood		
☐	Remote Area		
☐	Compressed Gases		
☐	Diving		
☐	Using Boats		
☐	Working Over Water		
☐	Traffic		
☐	Explosives		
☑	Heavy Equipment Operation	1,2,3	FLD 22A, 22B-DSG
☐	Lifting Equipment Operation		
	☐ Cranes		
	☐ Manlifts		
☐	Working at Elevation		
☐	Using Ladders		
☐	Using Scaffolding		
☑	Excavating/Trenching	1,2	FLD 28
☐	Materials Handling		
☑	Hazardous Materials Use/Storage	1,2,3,4	FLD30
	☑ Flammable liquid/gases	1,2,3	FLD30
	☐ Oxidizers		
	☐ Corrosives		
☐	Fire Prevention/Response Plan Required		
☑	Fire Extinguishers Required		
☐	Demolition		
☑	Utilities	1,2	FLD 34
	☑ Underground	1,2,3	FLD 34
	☐ Overhead		
☐	Electrical - General		
	☐ High Voltage		
☑	Welding/Cutting/Burning	1,2,3	FLD36
☑	Hand Tools	1,2,3	Inspection FLD38
☐	Power Hand Tools		
☑	High Pressure Water	1,2,3,5	Avoid steam FLD38
☐	Other:		
☐	Other:		
☐	Other:		

TASK-BY-TASK RISK ANALYSIS

The preceding tables identify the hazards known or suspected to be present in accomplishing the tasks involved in this project.

The levels of protection described below for use during field activities at Area B have been modified from EPA protocol and are based on the following total organic concentration levels for a 1-minute sustained reading in the breathing zone, as measured with a PID.

Protection Level	Concentration Range
Level D[a]	Background - 5 units above background
Level C[a]	5 - 50 units above background
Exit site, reevaluate condition with the SHSC	> 50 units

[a]If vinyl chloride or benzene is not present or present at concentrations below 1.0 ppm above background.
[b]If vinyl chloride or benzene is present at concentrations greater than 1.0 ppm

Task: Soil gas sampling (1)

Likelihood of Exposure:
Physical: low to moderate
Chemical: low to moderate
Radiological: low to moderate

Associated Hazards: In soil gas sampling, there is slight to no possibility for physical injury.

Chemical and radiological hazards occur when the soil gas is being extracted through the probe. Protective clothing will be worn to minimize dermal exposure. Continuous air monitoring will be performed to decrease the likelihood of extended periods of inhalation of organics or radionuclides.

It is anticipated that Level D protection will be used for this activity at Mound Plant. Air monitoring will be performed to ensure gas leakage is not occurring. If levels of organic vapors approaching 1.0 unit above background are detected with the photoionization detector in the breathing zone, Draeger detection tubes will be used to measure the concentration of chloroethene (vinyl chloride) and benzene. If either of these contaminants is present at concentrations greater than 1.0 ppm, Level B protection will be implemented. All work will stop until this plan can be revised for Level B work and appropriate personnel are obtained. Level C protection will be used, as necessary, to avoid the inhalation of particulates, radioactively contaminated particulates, and organic vapors if benzene and chloroethene are not present. If it become necessary to utilize Level B protection, work will be stopped, and the appropriate equipment and personnel will be obtained to continue working in Level B.

Task: Borehole drilling, piezometer and monitor well installation (2)

Likelihood of Exposure:
Physical: Moderate to high
Chemical: Low to moderate
Radiological: Low to moderate

Associated Hazards: Boreholes will be drilled using hollow stem auger and air mist methods. In drilling, there is a great possibility of physical injuries. A drill rig allows for entanglement and pinch points in many parts of the right. Other injuries may occur from failure of wire rope under extreme stress. If the rope breaks under high tension, it may recoil and can injure workers in the area.

Chemical and radiological hazards may occur when drilling disturbs or penetrates a contaminated pocket of soil. The rig will stir some dust and generate heat that may volatilize organics in the soil. These factors combine to greatly enhance the possibility of exposure to field personnel. However, the low concentration of contaminants expected in the work area minimize the potential for generation of measurable levels of contaminants. The SHSC will be cognizant of all operations on and near the drill rig and will inform individuals of unsafe working conditions or actions. Continuous air monitoring will be performed to decrease the likelihood of extended periods of organic/radionuclide inhalation. Protective clothing will be worn to minimize dermal exposure.

It is anticipated that Level D protection will be used for the drilling activities at Area B. However, if levels of organic vapors approaching 1.0 unit above background are detected with the photoionization detector in the breathing zone, Draeger detection tubes will be used to measure the concentrations of chloroethene (vinyl chloride) and benzene. If either of these contaminants is present at concentrations greater than 1.0 ppm, Level B protection will be implemented. All work will stop until this plan can be revised for Level B work and appropriate personnel are obtained. Level C protection will be used, as necessary, to avoid the inhalation of particulates, radioactively contaminated particulates, and organic vapors if benzene and chloroethene are not present. If it becomes necessary to utilize Level B protection, work will be stopped and the appropriate equipment and personnel will be obtained to continue working in Level B. While drilling is in progress, a CGI/O_2 meter will be placed near the well bore to continuously monitor the % LEL of combustible gases and the % oxygen. A miniram meter will be used to monitor airborne particulates, and an alpha scintillometer will be used to screen for alpha-emitting radionuclides.

AMMENDMENT 4

TASK-BY-TASK RISK ANALYSIS

Task: Preparatory earthwork and pilot hole installation (0)

Likelihood of Exposure:
Physical: moderate to high
Chemical: low to moderate
Radiological: low to moderate

Associated Hazards: Cut-and-fill benching will be will be performed using a track loader and shallow excavation will be performed using a backhoe. During earthwork activities, there is a possibility of physical injury to workers standing in the area of operational heavy equipment.

Boreholes will be drilled using cable-tool drilling methods. In drilling, there is a possibility of physical injuries. A drill rig allows for entanglement and pinch points. Other injuries may occur from failure of cables under extreme stress.

Chemical and radiological hazards may occur if benching, excavation, or drilling disturbs or penetrates a contaminated pocket of soil. Each rig can stir dust that may increase levels of airborne radiological particulates or generate heat that may volatilize organics in the soil. These factors combine to greatly enhance the possibility of exposure to field personnel. However, the low concentration of contaminants expected in the work area minimizes the potential for generation of measurable levels of contaminants. The SHSC will be cognizant of all operations on and near the heavy equipment or drill rig and will inform individuals of unsafe working conditions or actions. Continuous air monitoring will be performed to decrease the likelihood of extended periods of organic/radionuclide inhalation. Protective clothing will be worn to minimize dermal exposure.

It is anticipated that Level D Protection will be used for the earthwork and drilling activities at Area B. However, if levels of organic vapors approaching 1.0 unit above background are detected with the photoionization detector in the breathing zone, Draeger detection tubes will be used to measure the concentration of chloroethene (vinyl chloride) and benzene. If either of these contaminants is present at concentrations greater than 1.0 ppm, all work will stop and engineering control measures will be implemented to lower concentrations of organic vapors. During earthwork and drilling activities, a CGI/O_2 meter will be operated near the disturbed soils or borehole to continuously monitor the % LEL of combustible gases and the % oxygen. If the background levels of % LEL or % oxygen are exceeded in the breathing zone, work will be stopped until conditions stabilize. A miniram meter will be used to monitor airborne particulates. If the amount of airborne particulates exceeds 5 mg/L, engineering control measures (dust suppression) will be implemented to reduce airborne particulate levels. A pancake GM and a micro R meter will be used to measure low level radiation. If measurable radiation activity exceeds background levels, all work will be stopped and the client will be contacted. Work may not proceed until the radioactive contamination is removed.

Approval: Robert P. Schoenfelder
Robert Schoenfelder - Corporate Health and Safety

1/6/92
Date

TASK-BY-TASK RISK ANALYSIS

Task: Overdrilling Existing Boreholes and Installing Surface Casing With a Cable-Tool Drill Rig (3)

Likelihood of Exposure:
Physical: moderate to high
Chemical: low to moderate
Radiological: low to moderate

Associated Hazards: The overdrilling and surface casing installation program will begin in Level D protection, unless results from initial borehole drilling indicate a need for additional precautions and protection. In drilling, there is a great possibility for physical hazards. A drill rig allows for entanglement and pinch points in many parts of the rig. Other injuries may occur from failure of wire rope under extreme stress. If the rope breaks under high tension, it may recoil and can seriously injure workers in the area. No samples will be collected in the overdrilled holes. Drill rigs will be inspected daily (see Appendix C for drill rig inspection checklist) by the Field Team Leader or the SHSC at the drilling site.

Chemical and radiological hazards may occur when drilling disturbs or penetrates a contaminated pocket of soil. The rig will stir some dust and generate heat that may volatilize organics in the soil. These factors combine to greatly enhance the possibility of exposure to field personnel. However, the low concentrations of contaminants expected in the work areas minimize the potential for generation of measurable levels of contaminants (Figures 4.1 through 4.7). Because existing borehole are being enlarged during this task, air monitoring will only be performed in the boreholes that had positive instrument readings during installation of the borehole

Task: Soil sampling (4)

Likelihood of Exposure:
Physical: Low to moderate
Chemical: Low to moderate
Radiological: Low to moderate

Associated Hazards: In shallow surface soil sampling with a hand auger there is a slight possibility for physical injury. Physical injury could result from pinching, cutting, or bruising fingers and hands during augering. The hazards for power augering are similar to those of drilling. The potential for contact with chemically or radiologically contaminated soils is enhanced because this operation tends to stir more dust. A powered hand auger may still prevent the operator with entanglements and pinch point hazards but to a lesser degree than a drill rig. Protective clothing will be worn to minimize dermal exposure. Continuous air monitoring will be performed to decrease the likelihood of extended periods of organic/radionuclide inhalation.

It is anticipated that Level D protection will be used for the shallow soil sampling activity at Area B. However, if levels of organic vapors approaching 1.0 unit above background are detected with the photoionization detector in the breathing zone, Draeger detection tubes will be used to measure the concentrations of chloroethene and benzene. If either of these contaminants is present at concentrations greater than 1.0 ppm, Level B protection will be implemented. All work will stop until this plan can be revised for Level B work and appropriate personnel are obtained. Level C protection will be used, as necessary, to avoid the inhalation of particulates, radioactively contaminated particulates, and organic vapors if benzene and chloroethene are not present. If it becomes necessary to utilize Level B protection, work will be stopped and the appropriate equipment and personnel will be obtained to continue working in Level B. While augering is in progress, a CGI/O_2 meter will be placed near the well bore to continuously monitor the % LEL of combustible gases and the % oxygen. A miniram meter will be used to monitor airborne particulates, and an alpha scintillometer will be used to screen for alpha-emitting radionuclides.

Task: Aquifer pumping test (5)

Likelihood of Exposure: Low to moderate

Associated Hazards: Physical hazards for an aquifer pumping test are limited to cuts from frayed cables and monitor well casings, bruised feet from dropping pressure transducer cable or the data logger.

Chemical and radiological hazards occur when time series groundwater samples are collected. Field personnel will wear appropriate protection to limit dermal contact. Continuous air monitoring will be performed to decrease the likelihood of extended periods of organic/radionuclide inhalation.

It is anticipated that Level D protection will be used for the aquifer pumping test at Area B. However, if levels of organic vapors approaching 1.0 unit above background are detected with the photoionization detector in the breathing zone, Draeger detection tubes will be used to measure the concentrations of chloroethene and benzene. If either of these contaminants is present at concentrations greater than 1.0 ppm, Level B protection will be implemented. All work will stop until this plan can be revised for Level B work and appropriate personnel are obtained. Level C protection will be used, as necessary, to avoid the inhalation of particulates, radioactively contaminated particulates, and organic vapors if benzene and chloroethene are not present. If it becomes necessary to utilize Level B protection, work will be stopped and the appropriate equipment and personnel will be obtained to continue working in Level B.

TASK-BY-TASK RISK ANALYSIS

Task: Decontamination (6)

Likelihood of Exposure: Low

Associated Hazards: Physical hazards associated with equipment decontamination are limited to dropping equipment on appendages.

Chemical and radiological hazards occur from the potential collected decon rinse from the sampling equipment.

It is anticipated that Level D protection will be used during the sampling/decon phases of the investigation. However, if levels of organic vapors approaching 1.0 unit above background are detected with the photoionization detector in the breathing zone, Draeger detection tubes will be used to measure the concentrations of chloroethene and benzene. If either of these contaminants is present at concentrations greater than 1.0 ppm, Level B protection will be implemented. All work will stop until this plan can be revised for Level B work and appropriate personnel are obtained. Level C protection will be used, as necessary, to avoid the inhalation of particulates, radioactively contaminated particulates, and organic vapors if benzene and chloroethene are not present. If it becomes necessary to utilize Level B protection, work will be stopped and the appropriate equipment and personnel will be obtained to continue working in Level B.

Decon rinse will be captured and stored until analytical results allow for disposal methods to be determined. Protective clothing will be worn to minimize dermal exposure. Continuous air monitoring will be performed to decrease the likelihood of extended periods of organic/radionuclide inhalation.

PERSONNEL PROTECTION PLAN

Engineering Controls
Describe Engineering Controls used as part of Personnel Protection Plan:

Task(s) 1,2,3,4,5,6

N/A

Administrative Controls
Describe Administrative controls used as part of Personnel Protection Plan:

Task(s) 1,2,3,4,5,6

Withdraw when HNu, CGI, RAM dust, or radiation meter readings are within concentrations of concern.

Personnel Protective Equipment
Action Levels for Changing Levels of Protection. Define Action Levels for up or down grade for each task:

Task(s) 1,2,3,4,5,6

Upgrade when CGI, HNu, or RAM reading are above specified action levels. It is anticipated that Level D protection will be used for the remedial investigation activities at Area B on the basis of the soil gas data (HGC 1987). However, if levels of organic vapors approaching 1.0 unit above background are detected with the photoionization detector in the breathing zone, Draeger detection tubes will be used to measure the concentrations of chloroethene and benzene. If either of these contaminants is present at concentrations greater than 1.0 ppm, Level B protection will be implemented. Level C protection will be used, as necessary, to avoid the inhalation of particulates, radioactively contaminated particulates, and organic vapors if benzene and choloroethene are not present. If it becomes necessary to utilize Level B protection, work will be stopped and the appropriate equipment and personnel will be obtained to continue working in Level B. Revisions to this plan will be made to incorporate Level B protocol. The DAC for plutonium-238 and thorium-230 = 3×10^{-12} μCi/mL; and the limit for particulates in air = 5 mg/m^3. An upgrade to Level C will occur if these concentrations or limits are exceeded.

The levels of protection described below for use during field activities at Area B have been modified from EPA protocol and are based on the following total organic concentration levels for a 1-minute sustained reading in the breathing zone, as measured

Protection Level	Concentration Range
Level D[a]	Background - 5 units above background
Level C[a]	5 - 50 units above background
Exit site, reevaluate condition with the SHSC	> 50 units

[a]If vinyl chloride or benzene is not present or present at concentrations below 1.0 ppm above background.
[b]If vinyl chloride or benzene is present at concentrations greater than 1.0 ppm

Description of Levels of Protection — Level D

Task(s):	1	2	3	4	5	6
☑ Head	Hard hat	Hard hat	Hard hat	Hard hat	Hard Hat	Hard Hat
☑ Eye and Face	Safety glasses	Safety glasses	Safety glasses	Safety glasses	Safety glasses	Safety glasses
☑ Hearing	Ear plugs if needed	Ear plugs if needed	Ear plugs if needed	Ear plugs if needed	Ear plugs if needed	Ear plugs if needed
☐ Arms and Legs Only						
☑ Whole Body	Tyvek or coveralls Saranex when wet	Tyvek or coveralls Saranex when wet	Tyvek or coveralls Saranex when wet	Tyvek or coveralls if needed. Saranex when wet	Tyvek or coveralls if needed. Saranex when wet	Tyvek or coveralls if needed. Saranex when wet
☐ Apron						
☑ Hand - Gloves	Latex gloves	Latex gloves	Latex gloves	Latex gloves	Latex	Latex
☐ Gloves						
☐ Gloves						
☑ Foot - Boots	Steel toed boots	Steel toed boots	Steel toed boots	Steel toed boots	Steel toed boots	Steel toed boots
☐ Boots	Disposable boot covers if needed	Disposable boot covers if needed	Disposable boot covers if needed	Disposable boot covers if needed		
☐ Boots						

Description of Levels of Protection — Level C

Level C				
Task(s):	1	2	3	
☑ Head	Hard hat	Hard hat	Hard hat	
☑ Eye and Face	Safety glasses if needed	Safety glasses if needed	Safety glasses if needed	
☑ Hearing	Ear plugs as needed	Ear plugs as needed	Ear plugs as needed	
☐ Arms and Legs Only				
☑ Whole Body	Tyvek, Saranex when wet	Tyvek, Saranex when wet	Tyvek, Saranex when wet	
☐ Apron				
☑ Hand - Gloves	Latex (inner)	Latex (inner)	Latex (inner)	
☑ Gloves	Nitrile (outer)	Nitrile (outer)	Nitrile (outer)	
☐ Gloves				
☑ Foot - Boots	Latex or PVC covers	Latex or PVC covers	Latex or PVC covers	
☐ Boots				
☑ Boots	Steel toed	Steel toed	Steel toed	
☐ APR - Neg. Pres.				
☐ Half Face				
☑ Cart./Canister	GMC-H	GMC-H	GMC-H	
☑ Full Face				
☐ Cart./Canister				
☐ PAPR				
☐ Cart./Canister				
☐ Type C				
☐ SAR - Airline				
☐ SCBA				
☐ Comb. Airline/SCBA				
☐ Cascade System				
☐ Compressor				
☐ Fall Protection				
☐ Flotation				
☐ Other				

SITE OR PROJECT HAZARD MONITORING PROGRAM

Direct Reading Air Monitoring Instruments

Instrument Selection and Initial Check Record

Reporting Format: ☑ Field Notebook ☑ Field Data Sheets ☐ Air Monitoring Log ☐ Trip Report ☐ Other

Instrument	Task No.(s)	Number Required	Number Received	Checked Upon Receipt	Comment	Initials
☐ CGI				☐		
☐ O_2				☐		
☑ CGI/O_2	1,2,3,4,5			☐		
☐ CGI/O_2/tox-PPM, H_2S,H_2S/CO				☐		
☑ RAD-GM	0,1,2,3,4,5,6			☐		
☑ NaI (μR meter)	0,1,2,4,5,6			☐		
☑ FIDLER	0,1,2,4,5,6			☐		
☑ Other Alpha Scintillometer	0,1,2,3,4,5,6			☐		
☑ PID				☐		
☑ HNU 10.2	1,2,3,4,5			☐		
☐ HNU 11.7				☐		
☐ HNU 9.5				☐		
☐ Photovac, TMA, Other				☐		
☐ FID				☐		
☐ FOX-128				☐		
☐ FOX 128GC				☐		
☐ Heath, AID, Other				☐		
☑ RAM, Mini-RAM, Other	1,2,3,4			☐		
☐ Monitox-HCN				☐		
☐ H_2S				☐		
☐ COCL				☐		
☐ SO_2				☐		
☐ Other				☐		
☐ Bio-Aerosol Monitor				☐		
☐ Detector Tubes				☐		
☑ Pump - Dräeger	1,2,3,4,5			☐		
☑ Tubes/type: Benzene				☐		
☑ Tubes/type: Vinyl chloride				☐		

AMENDMENT 1

SITE OR PROJECT HAZARD MONITORING PROGRAM

Direct Reading Air Monitoring Instruments

Instrument	Task No.(s)	Number Required	Number Received	Checked Upon Receipt	Comment	Initials
micro R meter	~~0,2~~ 0,1,2,4,5,6			( )		
Pancake GM probe	0,1,2,3,4,5,6			( )		
RAS–1 Air Sampler	2,3			( )		
Ludlum model 2000	2,3			( )		
Ludlum 43–10 (alpha counter)	2,3			( )		
Ludlum 44–1 (beta counter)	2,3			( )		

Approval: Robert P. Schoenfelder
Bob Schoenfelder – Corporate Health and Safety

11/6/92
Date

SITE OR PROJECT HAZARD MONITORING PROGRAM

Direct Reading Air Monitoring Instruments

Direct Reading Air Monitoring Instruments Calibration Record

Instrument, Mfg., Model, Equip. ID No.	Date	Time	Calib. Material	Calib. Method Mfg.'s	Other	Initial Setting and Reading	Final Setting and Reading	Calibrator's Initials

SITE AIR MONITORING PROGRAM

Action Levels

These Action Levels, if not defined by regulation, are some percent (usually 50%) of the applicable PEL/REL/TLV. That number must also be adjusted to account for instrument response factors.

	Tasks	Action Level	Action
☑ **Explosive atmosphere**	1,2,3,4,5	<10% LEL	Continue investigation
		10% - 25% LEL	Continue onsite monitoring with extreme caution as higher levels are encountered
		>25% LEL	Explosion hazard. **Withdraw from area immediately.**
☑ **Oxygen**	1,2,3	<19.5%	Monitor wearing SCBA. NOTE: Combustible gas readings may not be valid in atmospheres with <19.5% oxygen.
		19.5% - 25%	Continue investigation with caution, as oxygen levels >21% require extreme caution. Other than normal level may be due to presence of other substances.
		>25%	Fire hazard potential. Stop work and consult a fire safety specialist.
☑ **Radiation**	1,2,3,4,5,6	3 x Bkg - <2 mR/hr	Radiation above background levels (normally 0.01-0.02 mR/hr) signifies possible source(s) radiation present.
			Continue investigation with caution. Perform thorough monitoring. **Consult with a health physicist.**
		>2 mrem/hr	Potential radiation hazard. Evacuate site. Continue investigation only upon the advice of a health physicist.
☑ **Organic gases and vapors**	1,2,3,4,5,6	Depends on chemical	Consult standard reference manuals for air concentration/toxcity data. Action level depends on PEL/REL/TLV.
☐ **Inorganic gases and vapors**			

AMENDMENT 2

SITE AIR MONITORING PROGRAM

Action Levels

Hazard	Tasks	Action Level	Action
Radiation	0, 1, 2,3,4, 5,6	1/3 ~~25%~~ of most conservative DAC (Thorium–232) – 1.25 x 10–13 uCi/ml gross alpha	Stop work and implement engineering control measures to lower concentration of airborn particulates
	0, 1, 2,3,4, 5,6	1/3 ~~25%~~ of most conservative DAC (Cesium–137) – 1.75 x 10–8 uCi/ml gross beta	Stop work and implement engineering control measures to lower concentration of airborn particulates
	0,1,2,3, 4,5,6	Measurable activity in excess of background on the pancake GM or micro R meter	Stop work, contact client, work may not proceed until contamination is removed

Approval: Robert P. Schoenfelder
Bob Schoenfelder – Corporate Health and Safety

11/16/92
Date

SITE AIR MONITORING PROGRAM

Ambient Air Sampling

Check situations which will require or action levels which will apply to deciding to institute or increase scope of planned air sampling.

☐ No air sampling is required on this site.

☑ An air sampling plan is incorporated in this HASP.

Meteorological Conditions

☐ Dry weather for ____ days

☐ Ambient temperature above ____ °F

☑ Wind increasing potential of more contaminant dispersion in or migration out of controlled area.

Activities which will require instituting or increasing scope of air sampling:

☐ Major spills

☐ New site activity resulting in potential presence of new chemical hazards.

☑ Site activity increases airborne contaminants possibilities.

☑ Air sampling documentation required for:

- ☑ Downgrading from stipulated level of protection
- ☐ Documenting no migration of contaminants offsite through air

Applicable Action Levels for instituting Air Sampling:

☑ Visible vapor/gas clouds or vapor levels, or

☑ Visible dust or particulate levels measured with Direct Reading Instrument, 2-3 times background or above action level, sustained over 10-15 minute period.

The following requirements apply to air sampling:

Sampling Matrix/Air Interface - Monitor matrix/air interface and breathing zone periodically with DRI. If vapor levels > 2-3 times background, monitor continuously. Follow Breathing Zone description below.

Container Opening - Monitor opening and breathing zone periodically with DRI. If vapor levels > 2-3 times background, monitor opening and breathing zone continuously. Follow Breathing Zone description below.

Excavation/Drilling/Intrusive Work - Monitor at ground level and breathing zone periodically with DRI. If vapor levels > 2-3 times background, monitor opening and breathing zone continuously. Follow Breathing Zone description below.

Breathing Zone - Ensure level of protection specified in HASP is being used. Consult HASP or Corporate Health and Safety relative to instituting personnel, area, or perimeter sampling.

☐ Other

SITE AIR MONITORING PROGRAM

Sample Location

	Locations	Substances Sampled For
☑ Ambient background	Tasks 1,2,3,4,5,6 locations PID, CGI, RAM, radiation meters	VOCs, radionuclides
☑ Personal samples, onsite	Tasks 1-6 locations TLD badges	Radionuclides
☐ Personal samples, offsite		
☐ Fixed, onsite samples		
☐ Fixed, offsite samples		
☐ Mobile offsite samples		
☑ Mobile onsite samples	Tasks 1-6 locations PID, CGI, RAM, radiation meters	VOCs, radionuclides
☐ Background sample stations		

SITE AIR MONITORING PROGRAM

Air Sampling

Personal Sampling Pumps - Gilian, SKC, MSA No. ___

Task(s)	Location	Duration	Frequency	Type	Analysis Method
Sampling Media - Sorbent Tubes					
Sampling Media - Filter					
Sampling Media - Impinger					
Sampling Media - Air Bag					

SITE AIR MONITORING PROGRAM

Air Sampling

Hi-Volume Pumps - Gilian, SKC, MSA

Sampling Media - Filter

Task(s)	Location	Duration	Frequency	Type	Analysis Method

Portable Gas Chromotograph Task(s): Type:

Portable GC Analytical Plan:

Passive Dosimeters

	Task(s)	Type	Location	Frequency	Duration
☐ Organic Vapor					
☐ Mercury Vapor					
☐ Paper Color Change					
☑ TLD	1,2,3,4,5,6	Eberline	All	All	All
☐ Film Badge					
☐ Liquid Media					

Wipe Sampling

Wipe Sampling Plan:

SITE AIR MONITORING PROGRAM

Air Sampling

Hi-Volume Pumps - Gilian, SKC, MSA

Sampling Media - Filter

Task(s)	Location	Duration	Frequency	Type	Analysis Method

Portable Gas Chromotograph Task(s): Type:

Portable GC Analytical Plan:

Passive Dosimeters

	Task(s)	Type	Location	Frequency	Duration
☐ Organic Vapor					
☐ Mercury Vapor					
☐ Paper Color Change					
☑ TLD	1,2,3,4,5,6	Eberline	All	All	All
☐ Film Badge					
☐ Liquid Media					

Wipe Sampling

Wipe Sampling Plan:

SITE AIR MONITORING PROGRAM

Physical Hazard and Miscellaneous Monitors and Detectors

	Task(s)	Calibration Required?/Method	Location	Frequency
☐ Sound Level Meter		☐		
☐ Noise Dosimeter(s)		☐		
☐ Octave Band Analyzer		☐		
☐ Electric Circ. Detector		☐		
☑ Thermometer		☑ No - direct reading	Tasks 2,5	N/A
☐ Wind Speed Indicator		☐		
☑ Barometer		☑ Yes - Task 4 Manufacturer's specifications	Onsite	Daily
☐ Psychrometer		☐		
☐ Infrared Thermometer		☐		
☐ Microwave Detector		☐		
☑ pH Meter		☑ Yes - Tasks 2,5	Onsite	According to SOPs 2.2, 4.4

Indicator Kits

	Task(s)	Location	Frequency
☐ pH Paper			
☐ Peroxide Paper			
☐ Chlor-N-Oil Kit			
☐ Hazard Categorizing Kit			
☐ Asbestos Test Kit			

DECONTAMINATION PLAN

Personnel Decontamination

Section III C. lists the tasks and specific levels of protection required for each. Consistent with the levels of protection required, step-by-step procedures for personnel decontamination for each Level of Protection are attached.

Levels of Protection Required for Decontamination Personnel

The levels of protection required for personnel assisting with decontamination will be:

☐ Level B
☐ Level C
☑ Level D

Modifications include: According to SOPs 1.8 and 1.9

Disposition of Decontamination Wastes

Provide a description of waste disposition including identification of storage area, hauler, and final disposal site, if applicable:

Place disposable protective clothing and decontamination fluids in plastic-lined drums. Clothing and decon fluids should be separated. Mound will store and dispose of these wastes.

Equipment Decontamination

A procedure for decontamination steps required for non-sampling equipment and heavy machinery follows:

According to SOP 1.6.

Sampling Equipment Decontamination

Sampling equipment will be decontaminated in accordance with the following procedure:

According to SOP 1.6.

CONTINGENCIES

Emergency Contacts and Phone Numbers

Agency	Contact	Phone Number
Local Medical Emergency Facility	Sycamore Hospital	(513) 296-7026
WESTON Medical Emergency Contact	AGATHA	(513) 421-3063
WESTON Health and Safety	Wilma Lombardo/Eric Larsen	(505) 884-5050
Fire Department	Fire Chief -Dave Heitz	7111 or (513) 865-313
Police Department	Security - Duty Officer	7111 or (513) 865-3400
Onsite Coordinator	Chuck Friedman	(513) 865-4541
Site Telephone	WESTON Trailer	(513) 866-6884
Nearest Telephone		TBD

Local Medical Emergency Facility(s)

Name of Hospital: Sycamore Hospital

Address: 2150 Leiter Rd. Miamisburg, OH — **Phone No.:** (513) 865-8491

Name of Contact: — **Phone No.:**

Type of Service:

- ☐ Physical trauma only
- ☐ Chemical exposure only
- ☑ Physical trauma and chemical exposure
- ☑ Available 24 hours

Route to Hospital:

See Figure 1 (Page 29). Mound Plant south to Benner Rd. and turn left (east) to Gebhart Church Rd. North on Gebhart Church Rd. to Leiter Rd. and turn right. Sycamore hospital is on the right about 0.5 mile.

Travel time from site: 5-6 minutes

Distance to hospital: < 5 miles

Name/No. of 24-hr Ambulance Service: Mound Fire Dept. Medical Response, Dial 7111

Secondary or Specialty Service Provider

Name of Hospital:

Address: — **Phone No.:**

Name of Contact: — **Phone No.:**

Type of Service:

- ☐ Physical trauma only
- ☐ Chemical exposure only
- ☐ Physical trauma and chemical exposure
- ☐ Available 24 hours

Route to Hospital (attach map):

Travel time from site:

Distance to hospital:

Name/No. of 24-hr Ambulance Service:

Response Plans

Medical - General

In case of minor injuries to personnel, first aid treatment will be initiated by trained personnel in the field. First-aid treatment is available from Mound Plant paramedic (ext. 7111). In case of serious injuries, the victim will be transported to Sycamore Hospital as soon as possible.

	Type	Location
First aid kit:	OSHA approved (First Responder)	In vehicles
Eyewash required ☑ Yes ☐ No	Location Onsite	Location OU 3 Trailer
Safety shower ☐ Yes ☑ No	Location	Location

Special First Aid Procedures

Hydrofluoric acid on site ☐ Yes ☑ No

Cyanides on site ☐ Yes ☑ No

Plan for Response to Fire/Explosion

A fire emergency will be handled by evacuating the work area and immediately notifying the Mound Plant fire department (ext. 7111). Only if a fire appears to be small and easily extinguishable will field personnel attempt to put out the fire with available fire extinguishers. The Mound Plant fire department will be notified of any fires. If an explosion occurs, all personnel will be evacuated, and no one will reenter the work area until it has been cleared by Mound Plant fire department personnel.

	Type	Location
Fire Exinguisher	BC	Vehicles

CONTINGENCIES

Response Plans

Plan for Response to Spill/Release			Plan for Response to Security Problems
Call 7111. Continue monitoring and arrange with Mound personnel to contain and clean up spill. If drums are encountered and not punctured, the excavation will be covered.			Contact Mound security.
Spill Response Gear	Description	Location	

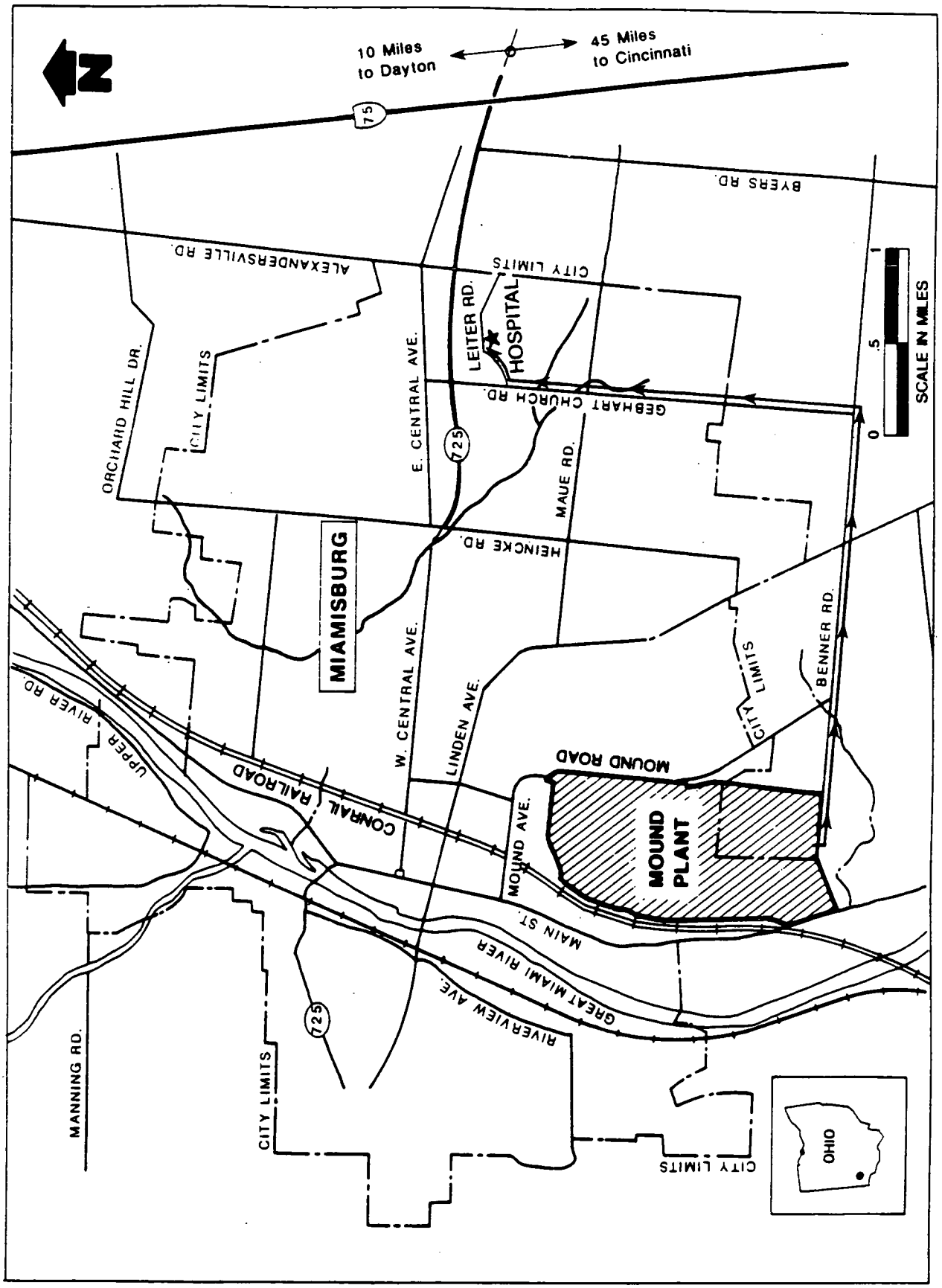

Figure 1. Route to hospital

SITE PERSONNEL AND CERTIFICATION STATUS

WESTON

Name: Eric Larsen **Title:** Field Team Leader/SHSC **Task(s):** 12,3,4,5 **Certification Level or Description:** C-S/B-T ☑ Medical Current ☑ Training Current ☑ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** Tom Tharp **Title:** Field Team Member **Task(s):** 1,2,3,4,5 **Certification Level or Description:** B-T ☑ Medical Current ☑ Training Current ☑ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** Ted Hartfelder **Title:** Field Team Leader **Task(s):** 1,2,3,4,5 **Certification Level or Description:** B-T ☑ Medical Current ☑ Training Current ☑ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)

MEDICAL CURRENT - Training: All personnel, including visitors, entering the exclusion or contamination reduction zones must have certifications of completion of training in accordance with OSHA 29 CFR 1910 29, CFR 1926/1910 or 20 CFR 1910.120.

FIT TEST CURRENT - Respirator Fit Testing: All persons, including visitors, entering any area requiring the use or potential use of any negative pressure respirator must have had as a minimum, a qualitative fit test, administered in accordance with OSHA 20 CFR 1910.134 or ANSI within the last 12 months. If site conditions require the use of a full face negative pressure, air purifying respirator for protection from Asbestos or Lead, employees must have had a quantitative fit test, administered according to OSHA 20 CFR 1910.1002 or 1025 within the last 6 months.

TRAINING CURRENT - Medical Monitoring Requirements: All personnel, including visitors, entering the exclusion or contamination reduction zones must be certified as medically fit to work, and to wear a respirator, if appropriate, in accordance with 29 CFR 1910, 20 CFR 1926/1910 or 29 CFR 1910.120.

The Site Health and Safety Coordinator is responsible for verifying all certifications and fit tests.

SITE PERSONNEL AND CERTIFICATION STATUS

Subcontractor's Health and Safety Program Evaluation

Name of Subcontractor: Hydro Geo Chem

Address: 1430 N. Sixth Avenue, Tucson, AZ 85705

Activities to Be Conducted by Subcontractor: Soil gas sampling

Evaluation Criteria

Medical program meets OSHA/WESTON criteria ☑ Acceptable ☐ Unacceptable Comments:	Personal protective equipment available Is as specified in WLHASP ☑ Acceptable ☐ Unacceptable Comments: WESTON will provide	Onsite monitoring equipment available, calibrated and operated properly ☑ Acceptable ☐ Unacceptable Comments:
Safe working procedures clearly specified ☑ Acceptable ☐ Unacceptable Comments:	Training meets OSHA/WESTON criteria ☑ Acceptable ☐ Unacceptable Comments:	Emergency procedures ☑ Acceptable ☐ Unacceptable Comments: Will follow plan
Decontamination procedures ☑ Acceptable ☐ Unacceptable Comments: Will follow plan	General health and safety program evaluation ☑ Acceptable ☐ Unacceptable Comments:	Additional comments:

Evaluation Conducted by: Jeff Slater EL November 10, 1992 **Date:** October 21, 1991

Subcontractor

Name: TBD **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)

SITE PERSONNEL AND CERTIFICATION STATUS

Subcontractor's Health and Safety Program Evaluation

Name of Subcontractor: Bowser and Morner

Address: 4518 Taylorsville, Rd., Dayton, OH 45424

Activities to Be Conducted by Subcontractor: Drill boreholes, excavate, abandon well 0055

Evaluation Criteria

Medical program meets OSHA/WESTON criteria ☑ Acceptable ☐ Unacceptable Comments:	Personal protective equipment available Is as specified in WLHASP ☑ Acceptable ☐ Unacceptable Comments: WESTON will provide	Onsite monitoring equipment available, calibrated and operated properly ☑ Acceptable ☐ Unacceptable Comments:
Safe working procedures clearly specified ☑ Acceptable ☐ Unacceptable Comments:	Training meets OSHA/WESTON criteria ☑ Acceptable ☐ Unacceptable Comments:	Emergency procedures ☑ Acceptable ☐ Unacceptable Comments: Will follow plan
Decontamination procedures ☑ Acceptable ☐ Unacceptable Comments: Will follow plan	General health and safety program evaluation ☑ Acceptable ☐ Unacceptable Comments:	Additional comments:

Evaluation Conducted by: Eric Larsen EL November 10, 1992 **Date:** February 28, 1992

Subcontractor

Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)

SITE PERSONNEL AND CERTIFICATION STATUS

Subcontractor's Health and Safety Program Evaluation

Name of Subcontractor: Northstar Drilling, Inc.

Address: P.O. Box 355, Little Falls, MN 56345

Activities to Be Conducted by Subcontractor: Drill boreholes, install piezometers, and monitoring wells

Evaluation Criteria

Medical program meets OSHA/WESTON criteria ☑ Acceptable ☐ Unacceptable Comments:	Personal protective equipment available Is as specified in WLHASP ☑ Acceptable ☐ Unacceptable Comments: WESTON will provide	Onsite monitoring equipment available, calibrated and operated properly ☑ Acceptable ☐ Unacceptable Comments:
Safe working procedures clearly specified ☑ Acceptable ☐ Unacceptable Comments:	Training meets OSHA/WESTON criteria ☑ Acceptable ☐ Unacceptable Comments:	Emergency procedures ☑ Acceptable ☐ Unacceptable Comments: Will follow plan
Decontamination procedures ☑ Acceptable ☐ Unacceptable Comments: Will follow plan	General health and safety program evaluation ☑ Acceptable ☐ Unacceptable Comments:	Additional comments:

Evaluation Conducted by: Eric Larsen EL November 10, 1992 **Date:** --

Subcontractor

Name: TBD **Title:** Driller **Task(s):** 2 **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)

SITE PERSONNEL AND CERTIFICATION STATUS

Subcontractor's Health and Safety Program Evaluation

Name of Subcontractor: Terran Co.

Address: P.O. Box 1410, Fairborn, OH 45324-1649

Activities to Be Conducted by Subcontractor: Aquifer test set-up and aquifer test

Evaluation Criteria

Medical program meets OSHA/WESTON criteria ☑ Acceptable ☐ Unacceptable Comments:	Personal protective equipment available Is as specified in WLHASP ☑ Acceptable ☐ Unacceptable Comments: WESTON will provide	Onsite monitoring equipment available, calibrated and operated properly ☑ Acceptable ☐ Unacceptable Comments:
Safe working procedures clearly specified ☑ Acceptable ☐ Unacceptable Comments:	Training meets OSHA/WESTON criteria ☑ Acceptable ☐ Unacceptable Comments:	Emergency procedures ☑ Acceptable ☐ Unacceptable Comments: Will follow plan
Decontamination procedures ☑ Acceptable ☐ Unacceptable Comments: Will follow plan	General health and safety program evaluation ☑ Acceptable ☐ Unacceptable Comments:	Additional comments:

Evaluation Conducted by: Eric Larsen EL November 10, 1992 **Date:** February 28, 1992

Subcontractor

Name: TBD **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
Name: **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)	**Name:** **Title:** **Task(s):** **Certification Level or Description:** ☐ Medical Current ☐ Training Current ☐ Fit Test Current (Qual.) ☐ Fit Test Current (Quant.)
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HEALTH AND SAFETY PLAN APPROVAL/SIGNOFF FORMAT

Site Name: Mound Plant **WO#** 2744-41-21

Address: 1 Mound Road, Miamisburg, OH 45343

I have read, understood, and agreed with the information set forth in this Health and Safety Plan (and attachments) and discussed in the Personnel Health and Safety briefing.

Name (Print)	Signature	Date
Site Health & Safety Coordinator		
Field Team Leader		
Field Team Leader		

TRAINING AND BRIEFING TOPICS

The following items will be covered at the site specific training meeting, daily or periodically.

☑ Site characterization and analysis, Sec. 3.0, 29 CFR 1910.120 i	☐ Daily	☑ Periodically
☑ Physical hazards, Table 3.2	☑ Daily	☐ Periodically
☑ Chemical hazards, Table 3.1	☑ Daily	☐ Periodically
☑ Animal bites, stings, and poisonous plants	☐ Daily	☑ Periodically
☐ Etiologic (infectious) agents	☐ Daily	☐ Periodically
☑ Site control, Sec. 8.0; 29 CFR 1910.120 d	☐ Daily	☑ Periodically
☐ Engineering controls and work practices, Sec. 8.5; 25 CFR 1910.120 g	☐ Daily	☐ Periodically
☑ Heavy machinery	☑ Daily	☐ Periodically
☐ Forklift	☐ Daily	☐ Periodically
☑ Backhoe	☐ Daily	☑ Periodically
☑ Equipment	☐ Daily	☑ Periodically
☑ Tools	☐ Daily	☑ Periodically
☐ Ladder 29 CFR 1910.27 d	☐ Daily	☐ Periodically
☑ Overhead and underground utilities	☑ Daily	☐ Periodically
☐ Scaffolds	☐ Daily	☐ Periodically
☐ Structural integrity	☐ Daily	☐ Periodically
☐ Unguarded openings - wall, floor, ceilings	☐ Daily	☐ Periodically
☐ Pressurized air cylinders	☐ Daily	☐ Periodically
☑ Personnel protective equipment, Sec. 5.0; 25 CFR 1910.120 g; 29 CFR 1910.134	☑ Daily	☐ Periodically
☑ Respiratory protection, Sec. 5.8; 29 CFR 1910.120 g; Z88.2-1980	☑ Daily	☐ Periodically
☐ Level A	☐ Daily	☐ Periodically
☑ Level B	☐ Daily	☑ Periodically
☑ Level C	☐ Daily	☑ Periodically
☑ Level D	☑ Daily	☐ Periodically
☑ Monitoring, Sec. 7.0; 29 CFR 1910.120 h	☑ Daily	☐ Periodically
☑ Decontamination, Sec. 9.0; 29 CFR 1910.120 k	☐ Daily	☑ Periodically
☑ Emergency response, Sec. 10.0; 29 CFR 1910.120 l	☑ Daily	☐ Periodically
☑ Elements of an emergency response, Sec. 100; 29 CFR 1910.120 l	☑ Daily	☐ Periodically
☑ Procedures for handling site emergency incidents, Sec. 10.0; 29 CFR 1910.120 l	☑ Daily	☐ Periodically
☐ Offsite emergency response, 29 CFR 1910.120 l	☐ Daily	☐ Periodically
☐ Handling drums and containers, 29 CFR 1910.120 j	☐ Daily	☐ Periodically
☐ Opening drums and containers	☐ Daily	☐ Periodically
☐ Electrical material handling equipment	☐ Daily	☐ Periodically
☑ Radioactive waste	☐ Daily	☑ Periodically
☐ Shock sensitive waste	☐ Daily	☐ Periodically
☐ Laboratory waste packs	☐ Daily	☐ Periodically
☐ Sampling drums and containers	☐ Daily	☐ Periodically
☑ Shipping and transport, 49 CFR 172.101	☐ Daily	☑ Periodically
☐ Tank and vault procedures	☐ Daily	☐ Periodically
☑ Illumination, 29 CFR 1910.120 m	☐ Daily	☑ Periodically
☑ Sanitation, 29 CFR 1910.120 n	☐ Daily	☑ Periodically

APPENDIX B

APPLICABLE ER PROGRAM SOPS AND OPERATING PRACTICES

STANDARD OPERATING PROCEDURE 1.1

GENERAL INSTRUCTIONS FOR FIELD PERSONNEL

1. PURPOSE

To provide field personnel with instructions regarding activities to be performed before, during, and after field investigations.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about procedures and equipment for a given operation. Refer to the FSP or WP for the type of samples, measurements, and tests to be collected or performed. The collection and documentation of data should be performed as described in specific SOPs. These general instructions are intended to supplement the information supplied in the FSP or WP and associated SOPs and clarify the role of field personnel at remedial investigations. These instructions will ensure that field personnel take the proper precautions to understand the site, the objective and the schedule for the field program, their authority, and their responsibilities described in the FSP or WP.

This SOP is supported by others that describe procedures and rationale for performing reconnaissance geophysical and soil gas surveys; soil and rock boring; sample logging; soil and sediment sample collection; installation and operation of vadose-zone instruments and samplers; groundwater monitoring well installation, development, and sampling; operation of sampling equipment; sample control and data documentation; performance of aquifer testing; collection, preservation, handling, packaging, and shipping of samples; decontamination procedures; health and safety monitoring; and radiological surveys.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of this SOP and SOPs 1.3-1.10 is required. In addition, a review of associated SOPs for each task is necessary. The associated SOPs are listed in Section 3.1 of each task SOP. Constant review of the SOPs will ensure that the work performed in the field is legally defensible, well documented, and cost-effective. The decontamination procedures are important for protecting the health and safety of workers, and to minimize the risk of cross-contamination among samples.

3.2. Preparation

3.2.1. Office

A. Personnel should review the FSP or WP and associated documentation for a specific operation and obtain all information related to the purpose and intent of the field program. This may include (but is not limited to) the documents listed below.

1. The scope of work or work plan described in the FSP or WP
2. Previous reports related to the site
3. Reports related to the area
4. Site maps
5. Area maps
6. Access agreements
7. The subcontractor's work plan
8. Data collection forms and equipment checklists
9. Associated SOPs

B. Field personnel are expected to maintain a good working relationship with the client, community, and subcontractors. With this in mind, field personnel should contact installation staff, members of the community (in coordination with installation staff), and subcontractors before work is initiated. During the initial contact, permission to enter private property or security areas should be obtained.

C. Obtain and test all equipment needed for the task. See checklist in Appendix 5.1.

D. Most sample analyses must be performed within a stringent time period. In addition, laboratories are vulnerable to heavy overloads. Contact the laboratory before sampling activities begin to ensure that the personnel are aware of specific requirements for analyses and can complete the work quickly and efficiently.

E. Delays at the freight office can be eliminated by contacting the carrier before arrival with a shipment. The carrier can supply information on regulations and specifications for shipping, the address of the nearest delivery office, and the time of the next freight pickup in the area.

3.2.2. Documentation

A. Obtain a logbook and ER Program data collection forms. All measurements, observations, and instrument readings should be entered on the forms according to the instructions supplied. All entries should be made in black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or NP for Not Performed. If any procedure was not performed as prescribed, give the reason for the change or omission in the comments field of the form. To change an entry to a form or field log book, draw a single line through it, add the correct information above it, and initial the change. Information that does not require data entry should be entered in the logbook. All logbooks are numbered, bound, and contain numbered pages for quality assurance/quality control purposes. Do not alter the logbook (e.g., tearing out pages) or data collection forms in any manner.

B. The information management codes and sample identification numbers used in data entry are assigned by the data administrator. The data administrator directly transmits the updated codes to the project personnel. This system is necessary to avoid duplication of site identifiers or inaccurate entries. Because the list of codes is continually being updated, SOPs cannot be revised each time a new list is produced.

C. Three days before leaving for any field trip, a previsit/pretravel report form must be submitted to DOE. The report contains information about dates of travel, mode of travel, hotel accommodations, and contact phone numbers. Arrangements for renting field vehicles should be made at this time.

3.2.3. Field

A. Check the condition and operation of all supplies and equipment at the site. Perform calibration checks specified in operators' manuals or appropriate SOPs.

B. Establish decontamination zones and barricades to public access.

3.3. Operation

A. The field personnel monitor and provide technical direction for the field work, log samples, take measurements, and sometimes pack and ship samples as required.

B. Under direction of the site manager, field personnel may designate sampling or hole locations, depth and completion zones, types of samples and depths of sample (or measured, if *in situ*), and approve and record procedures, materials, and all activities conducted in compliance with the FSP or WP.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a label affixed to the sample container--either a Soil Sample Identification Label or a Water Sample Identification Label. SOP 1.3, Sample Control and Documentation, contains copies of these forms and instructions for completing the forms.

C. Additional duties that the field personnel may perform are described below.

1. Keep a logbook to record information concerning equipment, personnel, site visitors, and activities (start and stop times, supplies used, footage drilled/installed, and site observations), as well as weather or site conditions affecting the activities. The field personnel should note all relevant instructions and information and document that proper QA/QC protocols have been followed. All information pertaining to a field activity should be entered in a bound book with consecutively numbered pages (see SOP 1.3, Sample Control and Documentation, for instructions on keeping the logbook). Subcontractors should sign/initial the daily log, thereby certifying that the account records agree with their estimates.

2. Telephone the site manager or office headquarters daily and provide a progress report.

3. Observe that the subcontractor complies with the FSP or WP and all applicable permits and licenses.

4. Complete all data collection forms according to applicable instructions as work progresses.

5. Observe whether the subcontractor follows the applicable health and safety requirements. If violations occur, the field personnel should stop work and immediately notify the site manager or site health and safety officer.

6. Monitor air, personnel, and equipment for contamination and record results on appropriate forms or in the logbook.

7. Supervise decontamination of equipment and personnel. Record procedures used for decontamination in the logbook. Collect decontamination solutions in containers for appropriate disposal as specified in the FSP or WP.

8. Notify the site manager of any modifications to the contract that may be appropriate. Work not defined in the FSP or WP should not be initiated without the approval of the site manager.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions as specified in the FSP or WP. Restoration can include repair of damage to the land surface (tire ruts) or private property (fences), as well as restoration anticipated at the time the FSP or WP was prepared (for example, revegetation or borehole abandonment).

C. Mark sampling locations or survey points with wooden lathe stakes, wooden survey pegs, or metal fenceposts. Write the location ID on the marker or survey flagging so that it is readily visible. Mark groundwater monitoring wells on the guard pipe and inside the casing cap. Use a black marker for wooden stakes, flagging, and the casing cap. Mark the guard pipes with welds or stencils and paint.

D. Shipping samples is the last task in most field operations. SOPs 1.3-1.5 should be used as guides to sample handling and transport. SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples, is a summary of Department of Transportation regulations pertaining to the transport of hazardous substances most commonly sampled in the field. Use SOP 1.5 in conjunction with the appropriate Code of Federal Regulations and guidance supplied by the freight carrier to ensure that packages are documented and properly labeled.

3.4.2. Documentation

A. Record any restoration work in the logbook.

B. Record any uncompleted work in the logbook. This record may include sampling that could not be performed, damage that could not be repaired, or requirements for long-term monitoring (for example, the need to verify instrument readings at different times of the year).

C. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

D. Review data collection forms for completeness.

E. Submit a travel expense report.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

None.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Overshoes

_____ Work gloves (2 pairs)

_____ Acid (10% HCL) bottle

_____ Clipboard case

_____ Strapping tape

_____ Pin hammer

_____ Tape measure (tenths)

_____ Protractor

_____ Hat

_____ First aid kit

_____ Sun screen

_____ Thermoluminescent dosimeter (TLD)

_____ Safety shoes/boots

_____ Ziplock bags

_____ Preprinted labels

_____ Distilled (organic-free) water

_____ Methanol (Nanograde)

_____ Freight forms

_____ Telephone directories

_____ Chain-of-custody forms

_____ Hard hat

_____ Pieces of wood (2 inches x 2 inches x 8 inches) to indicate core loss intervals

APPENDIX 5.1, continued

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stamped, addressed envelopes (large and regular sizes)

_____ Phone and gas credit cards

_____ Calculator

_____ Pens, pencils, and permanent markers

_____ Package cord

_____ Flagging

_____ Hand lens

_____ Tool box

_____ Rain suit

_____ Camera

_____ Ear plugs

_____ Stopwatch

_____ Cold-weather gear

_____ Alpha meter

_____ Safety glasses

_____ Kitchen screen (determine lithology)

_____ Ice chest

_____ Bound logbook

_____ Data collection forms

STANDARD OPERATING PROCEDURE 1.3

SAMPLE CONTROL AND DOCUMENTATION

1. PURPOSE

To define the steps necessary for sample control and identification, data recording, and chain-of-custody documentation.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected and the destination of the collected samples. Collection and measurement of samples and the documentation of data will be performed as described in specific SOPs.

This SOP describes the methodology of sample control and documentation for all projects. Sample control and documentation are necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, correspondence, sample labels or tags, chain-of-custody reports, photographs, and analytical records. Waterproof black ink must be used in recording all data in documents bearing serial numbers.

The logbooks are under the supervision of the quality control officer. There may be several logbooks; for example, there may be a separate logbook for field activities, one for samples, and one for instruments. The QA officer numbers the logbooks and assigns them to individuals designated for specific tasks of the project. All information pertinent to a field activity must be entered into a logbook. A record of uncompleted work is kept in a logbook. All project logbooks are turned over to the document control officer at the end of each work period and to a central file at the end of the field activity.

All logbooks are numbered and bound, and the pages are numbered. Waterproof black ink is used for recording all data. Logbook pages should never be removed, and no data should removed. To change an incorrect entry, the individual draws a line through the entry, writes the change above the entry, dates and initials the change. If anyone other than the person to whom the logbook is assigned makes an entry, that person dates and signs the entry. Blank (skipped) pages in the log-book should be marked so that no additional entries can be made on it.

Record all information pertinent to the sampling activity (for example, date, site, ID number, and location) in the logbook. Note the field conditions, weather conditions, and any unusual circumstances. Notes should be as descriptive and inclusive as possible. A person reading the entries should be able to reconstruct the sampling situation from the recorded information. Language should be objective, factual, and free of personal feelings and inappropriate terminology.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.4	Sample Containers and Preservation
1.5	Guide to the Handling, Packaging, and Shipping of Samples

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

Field preparation requires organizing sample bottles, sample labels, and documentation in an orderly, systematic manner that promotes consistency and traceability of all data. Appropriate items should be completed before a sample is collected.

A. Record all pertinent information (for example, date, site, ID number, and location) in the logbook. Note field conditions, unusual circumstances, and weather conditions.

B. Fill out information on the sample identification label and attach the label to a sample bottle.

C. Complete initial information required on data collection forms.

3.3. Operation

3.3.1. Logbook

Enter all information pertinent to a field activity in a bound logbook with consecutively numbered pages. Enter information that does not require data entry into the logbook. If not included on a data collection form, entries in the logbook should include at least the information listed below.

- Date and time of entry
- Purpose of sampling
- Name and address of field contact
- Site identification
- Type of process producing waste (if known)
- Type of sample (soil, water, sediment, etc.)
- Sample identifier and size of sample taken
- Type of analysis requested
- Description of sampling point or location number
- Date and time for collection of sample
- Collector's sample identification number(s) and/or name
- References of the sampling site (like maps or photographs)
- Field observations and sampling locations
- Associated field measurements
- Method of sample collection, preservation techniques/reagents used, and any deviations or anomalies noted

- Transfer of a logbook to individuals designated for specific tasks of the project

- Any uncompleted work

For water samples, the TEGD suggests the following additional information.

- Presence of immiscible layers and detection method

- Collection method for immiscible layers

- Sample distribution and transporter

- Climatic conditions including air temp

- Internal temperature of field and shipping container

Because sampling situations vary widely, make notes as descriptive and inclusive as possible. A person reading the entries should be able to reconstruct the sampling situation from the recorded information. Use language that is objective, factual, and free of personal feelings or any other inappropriate terminology. If anyone other than the person to whom the logbook was assigned makes an entry, he/she should date and sign the entry. Never remove logbook pages. If a mistake is made, draw a single line through the mistake, write the new information above the line, and date and initial the change.

3.3.2. Photographs

Photographs provide the most accurate record of the field worker's observations. They can be significant during future inspections, informal meetings, and hearings. A photograph must be documented to be a valid representation of an existing situation. For each photograph taken, record the items listed below in the logbook and on the back of each processed photograph.

- Date and time

- Signature of photographer

- Name and identification number of site

- Type of camera, lens, f-stop, shutter speed, and film used

- General direction faced and description of the subject

- Distance from photographer to object

- Location at the site

- Sequential number of photograph and the roll number

Any remarks about the contents of a photograph could jeopardize its value as legal evidence, so limit comments to the photograph's location. Photographs should be taken with a perspective similar to that afforded by the naked eye. Telephoto or wide-angle shots cannot be used in enforcement proceedings.

3.3.3. Sample Labels

Use soil and water sample identification labels to tag or label sample containers. Seal each sample immediately after it is collected and labeled with waterproof black ink. Label tags may be filled out before collection to minimize the handling of the sample containers. Appendix 5.1, Soil Sample and Water Sample Identification Labels, provides examples of the common sample labels to be used. Instructions for completing the labels are included in Appendix 1.3, Data Form Completion.

When appropriate, use an etching tool to mark sample containers in the field, rather than immediately applying a sample label or tag. This avoids possible label contamination problems and subsequent decontamination difficulties. In this case, write the data intended for the sample label in the logbook and transcribe them onto the label after the sample containers have been decontaminated.

Firmly attach the labels to the sample containers. The containers must be dry enough for gummed labels to be securely attached.

3.3.4. Sample Collection and Inventory

The number of persons involved in collecting and handling samples should be kept to a minimum. Use the guidelines established in this SOP and SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples. Complete data collection forms at the time the sample is collected and have the sample collector(s) sign or initial them. Include the date and time. On liquid containers, mark the liquid level with waterproof black ink. This requirement is not necessary for completely filled volatile organics analysis (VOA) septum vials. If the volume received by the laboratory is different than when collected, the sample container may have leaked, been tampered with, or spilled hazardous materials. Use the Custody Transfer Record/Lab Work Request form, Appendix 5.2, to inventory all samples collected in the field. Instructions for the form are in Appendix 5.3, Data Form Completion.

3.3.5. Chain of Custody

A. Objectives

The primary objective of the chain-of-custody procedure is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and introduction as evidence. A sample is in someone's custody when one of the criteria listed below has been satisfied.

1. The sample is in one's actual possession.

2. The sample is in one's view after being in one's physical possession.

3. The sample is in one's physical possession and is then locked up so that no one can tamper with it.

4. The sample is kept in a secured area that is restricted to authorized personnel.

B. Transfer of Custody and Shipment

When transferring the samples, the transferee should sign and record the date and time on the Custody Transfer Record/Lab Work Request form. Custody transfers made to a sample custodian in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody should fill in the appropriate section of the Custody Transfer Record/Lab Work Request form. To reduce the number of custody records, minimize the number of custodians in the chain of possession.

The field custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory. This responsibility includes filling out, dating, and signing the appropriate portion of the Custody Transfer Record/Lab Work Request form. The chain-of-custody form is then placed in a sealed plastic bag and taped to the inside of the cooler lid, where it is immediately visible when the cooler is opened. Signed and dated chain-of-custody seals are also placed on the sample container lids to detect sample tampering.

In general, packaging of environmental samples will include the following: placement of sample containers in zip-lock plastic bags to reduce the chance of both breakage and release of sample if breakage does occur, and placement of the bagged sample containers in a cooler containing sufficient vermiculite to prevent breakage and to absorb any material that leaks. For water samples in 4L amber glass containers, the samples will be wrapped in "bubble wrap" to prevent breakage. Ice or blue ice is used to maintain sample temperatures at 4°C. If ice is used, it must be double-bagged in zip-lock bags. Experience has shown that fully 1/4 to 1/3 of the cooler volume must be ice, packaged around and over the sample containers, to maintain temperatures at 4°C.

Send all packages to the laboratory with the chain-of-custody record and other pertinent forms. Retain a copy of these forms at the originating office (either carbon or photocopy). Register mailed packages with a return receipt requested. For packages sent by common carrier, retain receipts as part of the permanent chain-of-custody documentation. Pack samples so that they do not break in shipment. Seal the cooler with chain-of-custody seals so that any tampering can be readily detected. SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples, describes these procedures in detail.

3.4. Postoperation

3.4.1. Field

A. Verify that all sample bottles have been correctly identified and labels have all necessary information (location, time, and date).

B. Cross-check filled sample bottles in possession against those recorded in the logbook. Maintain custody of filled sample bottles by keeping them in actual possession, within view, locked or sealed up to prevent tampering, or bringing them into a secure area.

C. Prepare samples for transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record data and any uncompleted work in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial and date all pages.

C. Document the chain of custody on the Custody Transfer Record/Lab Work Request form.

D. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

EPA. 1986. "RCRA Ground-water Monitoring Technical Enforcement Guidance Document." U.S. Environmental Protection Agency document. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Soil Sample and Water Sample Identification Labels

5.2. Custody Transfer Record/Lab Work Request Form

5.3. Data Form Completion

APPENDIX 5.1

SOIL SAMPLE AND WATER SAMPLE IDENTIFICATION LABELS

SOIL SAMPLE IDENTIFICATION LABEL

FACILITY CODE _____ LOCATION ID _____

SAMPLE ID _____ LOG DATE _____

LAB CODE _____ LOG TIME _____

SAMPLER _____ LOGGER CODE _____

SAMPLE DEPTH INTERVAL FROM DATUM

BEGINNING DEPTH (FT FROM DATUM) _____

ENDING DEPTH (FT FROM DATUM) _____

ANALYSIS REQUESTED _____

COMMENTS _____

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WATER SAMPLE IDENTIFICATION LABEL

FACILITY CODE _____ LOCATION ID _____

SAMPLE ID _____ LOG DATE _____

LAB CODE _____ LOG TIME _____

SAMPLER _____ LOGGER CODE _____

ANALYSIS REQUESTED _____

PRESERVATION METHOD _____

COMMENTS _____

WSL-133

APPENDIX 5.2

CUSTODY TRANSFER RECORD/LAB WORK REQUEST FORM

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

Client _____
Work Order _____
Date Rec'd. _____ Date Due _____
RFW Contact _____
Client Contact/Phone _____

Refrigerator#											
#/Type Container											
Containers/Volume											
Preservative											
ANALYSES REQUESTED ➡											
WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected								

Matrix:
S - Soil
SE - Sediment
SO - Solid
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
F - Fish
X - Other

Special Instructions:

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y N
NOTES:

4 Properly Preserved
Y N
NOTES:

5 Received Within Holding Times
Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Unbroken on Outer Package Y N
3 Present on Sample Y N
4 Unbroken on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

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APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NP for Not Performed, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form in the comments field. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

SOIL SAMPLE IDENTIFICATION LABEL

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

3. Lab Code. Three-character code identifying the company responsible for performing the analysis of water, soil, biota, and air samples.

4. Sampler. Name of person(s) collecting sample.

5. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, and radiological samples are collected, and/or other measurements are taken.

6. Log Date. The date the information recorded on the label was obtained in the format DD-MMM-YY (01-JAN-88).

7. Log Time. The time the sample was collected (HH:MM).

8. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

9. Sample Depth Interval from Datum:

   a. Beginning Depth (Ft From Datum). Depth from the ground surface to the top of the sampling interval in the format of feet and tenths of feet.

   b. Ending Depth (Ft From Datum). Depth from the ground surface to the bottom of the sampling interval in the format of feet and tenths of feet.

10. Analysis Requested. Type of analysis requested.

11. Comments. Any additional information.

APPENDIX 5.3, Continued

WATER SAMPLE IDENTIFICATION LABEL FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

3. Lab Code. Three-character code identifying the laboratory responsible for performing the analysis.

4. Sampler. Name of person(s) collecting sample.

5. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, and radiological samples are collected, and/or other measurements are taken.

6. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

7. Log Time. Time the sample was collected (HH:MM).

8. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

9. Analysis Requested. Type of analysis requested from the laboratory.

10. Preservation Method. Type of preservative used.

11. Comments. Any additional information.

CUSTODY TRANSFER/LAB WORK REQUEST FORM

1. Received By. Completed by lab.

2. Date. Completed by lab.

3. Assigned To. Completed by lab.

4. Client. Client name.

5. Client Contact. WESTON person who will be laboratory contact.

6. Phone. Phone number of WESTON contact.

7. RFW Contact. Laboratory contact.

8. Date Due. Date analysis is due from the laboratory.

9. Project Number. Project number under which work is billed.

10. Sample No. Completed by laboratory.

11. Client ID No. Three-part identifier consisting of facility code, location ID, and sample ID and separated by dashes (for example, KCP01-01-01 and PXT02-0002-0001). See the ER Program data administrator for conventions to identify field quality control samples.

12. Description. Any descriptive information about the sample.

13. Matrix. Matrix type for sample; see valid matrix codes on lower half of form.

14. Date Collected. Date the sample was collected in the format DD-MMM-YY (01-JAN-88).

15. Container/Preservative. Container size and type (500-ml glass).

16. Analysis Requested. The type of analysis requested for each sample. The column heading indicating the type.

    PCB=Polychorinated Biphenyl

    HE=High Explosive

    HSL=Hazardous Substance List

    EPTOX=Extraction Procedure Toxicity

    VOA=Volatile Organic Analysis

APPENDIX 5.3, Concluded

CUSTODY TRANSFER/LAB WORK REQUEST FORM

BNA=Base Neutral Acid

TCLD=Toxic Characterization Leach Procedure

PEST=Pesticides

MAJ=Major Cation/Anion

17. Matrix. Valid matrix codes.

18. Special Instructions. Any special instructions.

19. Items/Reason. The reason the custody is transferred for all or selected items of the shipment.

20. Relinquished By. Signature of person sending samples.

21. Received By. Person or (shipping company) who received samples.

22. Date. Date sample is sent.

23. Time. Time sample is sent.

STANDARD OPERATING PROCEDURE 1.4

SAMPLE CONTAINERS AND PRESERVATION

1. PURPOSE

To provide guidance in the selection of suitable containers for samples, container cleaning, required sample volumes, sample collection, holding times, and the recommended preservation techniques for water, wastes, sediments, sludges and soil samples.

2. GENERAL DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a given operation and establishes the number, types, and analyses of field samples (including field analyses). Refer to the FSP or WP for the procedures and equipment to be used in collecting samples. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

In choosing a sample container, the ideal material should be nonreactive with the sample and the particular analytical parameter to be tested. Glass or Teflon containers must be used with samples analyzed for organic compounds to prevent the introduction of extraneous organic compounds, such as those that might be leached from plastic containers. The rigid plastic screw caps for the bottles must be Teflon lined to prevent contamination.

Once a sample has been collected, steps must be taken to preserve the sample's chemical and physical integrity during transport and storage before analysis is conducted. The type of sample preservation required will vary according to the sample type and the parameter to be measured.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.3	Sample Control and Documentation
1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.8	Sampling for Volatile Organics

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Sample Container Preparation

Sample containers will vary according to the matrix and nature of the sample to be collected. Wide-mouth containers are generally used for soils and wastes; narrow-mouth containers are used for water. Calculations should be made to determine the number and type of containers required for the sampling effort, including extra bottles for contingencies.

Procurement of containers should be initiated as early as possible to avoid unavailability and shipping delays and to satisfy cleaning requirements. Obtain the required number of sample bottles included in the FSP or WP of a type consistent with recommendations in EPA-600/4-79-020 (EPA 1979). Sample containers can usually be obtained directly from the laboratory performing the analyses.

A. Container Type

1. Identify the containers required for analysis by matrix as shown in Appendixes 5.2 through 5.7 (for example, amber glass, narrow-mouth bottles for PCB analysis of water samples). Confirm the container requirements with the analytical laboratory and the FSP or WP.

2. Calculate the number of each type of container required by including duplicates and blanks with the number of investigative samples specified in the FSP or WP. Also include extra bottles for contingencies.

B. Container Cleaning

Containers certified as being precleaned to EPA specifications will be obtained from the manufacturer through the laboratory. If certified containers are not obtained, follow the procedures outlined below to wash containers and caps. The person washing containers must wear gloves.

1. Inorganic and general parameters

   a. Wash containers, septa or liners, and closures in hot tap water with laboratory-grade, nonphosphate detergent.

   b. Rinse three times with tap water.

   c. Rinse three times with ASTM Type I deionized water (EPA 1979).

   d. Oven dry containers, septa or liners, and closures.

   e. Remove containers, septa or liners, and closures from oven.

   f. Place liners in closures (Teflon side down) and place on containers. Containers should not be removed from the preparation room until sealed.

2. Trace metals

   For certain parameters, a special cleaning procedure is needed to avoid adsorption or contamination resulting from interaction with container walls. These procedures are outlined below.

   a. Wash containers, closures, and Teflon liners in hot tap water with laboratory-grade, nonphosphate detergent.

   b. Rinse three times with tap water.

   c. Rinse one time with 1:1 nitric acid.

   d. Rinse three times with ASTM Type I deionized water (EPA 1979).

   e. Air dry in a contaminant-free environment.

   f. Place liners in closures and place closures on containers. Containers should not be removed from the preparation room until sealed.

3. Extractable Organics

   a. Wash glass bottles, Teflon liners, and caps with hot tap water using laboratory-grade, nonphosphate detergent.

   b. Rinse three times with tap water to remove detergent.

c. Rinse three times with ASTM Type I organic-free water (EPA 1979).

d. Oven dry bottles, liner, and caps to 105^0 - 125^0 for one hour.

e. Rinse with pesticide-grade hexane or pesticide-grade methylene chloride.

f. Oven dry bottles, liner, and caps to 105^0 - 125^0 for one hour.

g. Allow bottles, liners, and caps to cool to room temperature in an enclosed contaminant-free environment. Cap the containers after the glassware has been cooled.

h. Store in a contaminant-free area.

4. Volatile Organics Samples Containers

a. Wash glass vial, Teflon-based septa, Teflon liners, and caps in hot water using laboratory-grade, nonphosphate detergent.

b. Rinse three times with tap water.

c. Rinse three times with ASTM Type I organic-free water (EPA 1979).

d. Oven dry vial, caps, septa, and liner at 105^0 for one hour.

e. Allow vial, caps, septa, and liners to cool to room temperature in an enclosed contaminant-free environment.

f. Seal vials with septa (Teflon side down) and cap.

g. Label each vial with lot number and pack in the case.

h. Store in contaminant-free area.

5. Sterilization

a. For microbiological analyses, sterilize the container and its stopper/cap by autoclaving at 121°C for 15 min or by dry heat at 180°C for 2 hrs.

b. The sample bottles can be wrapped with aluminum foil before sterilization. Remove the protective wrapping after the sample is taken to facilitate cleaning the bottle before shipment to the analytical laboratory.

c. An acceptable alternative for emergency or field use is the sterilization of containers by boiling in water for 15 min.

3.2.4. Sample Volume

The volume of sample collected should be sufficient to perform all the required analyses plus an additional amount to provide for any quality control needs, split samples, or repeat examination. The volumes listed in Appendixes 5.2 through 5.7 are intended as general guidelines. Specific volume requirements to be followed will be those specified in the appropriate Work Plan, and/or Field Sampling Plan.

The laboratory receiving the sample should be consulted for specific volume requirements, and these should be specified in the FSP or WP.

NOTE: A sufficient number of containers must be available to ship the proper sample volume. For example, Department of Transportation (DOT) and International Air Transport Association (IATA) regulations limit the size of a sample container to 16 oz if the contents may include hazardous materials. In this case, two 500-ml or four 250-ml containers would be required to ship a one-liter fluid sample. See SOP 1.5, Guide to the Handling, Packaging, and Shipping of samples for additional information.

3.2.5. Sample Preservation

Sample containers may arrive at the site with the proper type and amount of preservatives in them. If onsite preservation of the samples is necessary, the proper reagents should be provided for the field crew in an easily usable form that can be added at the time of sampling. Preservation required for the specific analyses requested may be determined by using Appendixes 5.2 through 5.7. The preservation requirements specified in the Work Plan and/or Field Sampling Plan will take precedence over Appendixes 5.2 through 5.7. Materials commonly needed for sample preservation are listed below.

1. Small bottles of pelletized NaOH
2. Ascorbic acid crystals
3. Lead acetate paper and pH paper
4. Calibrated sampling scoops
5. Reagent-grade acids (HNO_3, HCl, and H_2SO_4) in Safe-Kote bottles
6. Calibrated dispenser bottles (0.5 to 2 ml) for acids.

3.2.6. Field

The appropriate number and type of precleaned containers, along with preservatives, equipment, and packaging containers, should be stored in a facility that can be locked or guarded. The storage facility should be located near the site and decontamination staging area, but should also be accessible to freight trucks that will be delivering new container shipments and transporting samples to the laboratory.

3.3. Operation

A. Soils/Wastes Sample Collection

NOTE: All individuals in the sampling area must wear gloves appropriate to their tasks. Only the persons collecting samples and filling sample containers must discard their gloves between sampling tasks (e.g. sample set).

1. While wearing protective gloves, fill the bottle with the sample. Wet soils should have enough headspace to allow for expansion.

2. Take extreme care to avoid contamination of the bottles or caps. Remove the cap just before filling and replace it as soon as possible after filling. Avoid any personal contact with the inside of the bottle or cap.

3. Clean the exterior of the bottle with a wipe moistened with deionized water, followed by a wipe moistened with methanol. When appropriate, implement SOP 1.6, General Equipment Decontamination. Attach a completed sample label (according to SOP 1.3, Sample Control and Documentation) and cover with clear tape. The tape should extend at least 1/4 inch beyond the edges of the label. Wrap a strip of Parafilm around the junction of the bottle and cap.

4. Preservation of soil samples is usually accomplished by protecting the sample from UV light by using an amber bottle and keeping the sample cool.

5. If required, place the container in a cooler. Maintain the samples at a cool temperature with frozen packaged ice (for example, Blue Ice) or ice cubes sealed in two plastic bags. Avoid freezing the sample by packing to prevent contact between the coolant and the sample container.

6. If samples are not delivered to the laboratory on a daily basis, check ice chests and insulated boxes every 24 hrs and replace thawed ice or Blue Ice packs as needed.

7. Avoid exposing the sample to extreme hot or cold temperatures and intense sunlight, even if no specific preservation is recommended.

8. EPA guidance recommends that a 4°C temperature be maintained in the sample container before and during shipment. The temperature in the packed container should be confirmed to be 4°C before the samples are shipped. A temperature reading from the middle of the package near the containers is satisfactory for this purpose.

   The temperature should be checked again at the analytical laboratory. Record both temperatures in the special instructions section of the Custody Transfer Record/Lab Work Request form (see SOP 1.3., Sample Control and Documentation). If a continuous temperature record can be obtained during the shipment period, record the maximum temperature in the container on the custody transfer form.

B. Water Sample Collection

NOTE: All individuals in the sampling area must wear gloves appropriate to their tasks. Only the persons collecting samples and filling sample containers must discard their gloves between sampling tasks (e.g., sample set).

1. Before collecting samples for organics and CN, use the Hach Test Kit for residual chlorine and sulfides. If present, preserve samples according to instructions in Appendix 5.2, Recommendation for Sampling and Preservation of Water Samples According to Measurement (for example, $Na_2S_2O_3$ to organic samples).

2. Collect samples directly in the appropriate container, ensuring that the sampling flow rate, if applicable, does not exceed the flow rate used while

purging. Collect samples in the order of their volatilization sensitivity (TEGD).

1) Volatile organics

2) Extractable organics

3) Dissolved metals

4) Total metals

5) Cations

6) Anions

7) Radionuclides

3. Do not filter unless specified in the Sampling Plan.

4. Do not rinse the container.

5. Slowly fill each container almost full, except VOAs (see SOP 2.8, Sampling for Volatile Organics).

6. Add any prescribed preservative.

7. Cap the container, shake, and reopen it.

8. If using acid or base preservative, check the pH adjustment with pH paper.

9. If necessary, add more preservative.

10. Complete steps 3 and 5 through 8 from Section 3.3.A.

11. If an error was made in collection, discard the entire bottle and start with a new one.

C. Holding Time

In general, analyze samples as soon as possible after collection. Some parameters are required to be analyzed in the field (See Appendix 5.2). Allowable holding times are listed as guidelines. They represent the maximum times that samples are considered valid. The typical required holding times for each analyte (or analysis group) are presented in Appendix 5.2. However, the Work Plan and/or Field Sampling Plan will specify holding times on a project-specific basis and, if different, take precedence over the Appendix 5.2 limits. There are instructions in the FSP or WP for delivering the samples to the laboratory as soon as possible. (See SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples).

3.4. Postoperation

3.4.1. Field

A. Store unused, clean sample bottles in a clean environment for later use.

B. Clean acid dispensers and store them dry for the next field operation.

C. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

D. Restore the site to presampling conditions as specified in the FSP or WP.

E. Make sure all wells are labeled, sampling locations are properly staked, and the location ID is readily visible on the guard pipe or location stake.

F. Prepare samples for transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record any cleanup procedures and any uncompleted work (like site restoration or uncompleted sampling) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Korte, Nic, and Peter Kearl. 1985. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition." U.S. Department of Energy report GJ/TMC-08. Technical Measurements Center, Grand Junction Project Office, Grand Junction, Colorado.

EPA. 1979. "Handbook for Analytical Quality Control in Water and Wastewater." U.S. Environmental Protection Agency report EPA-600/4-79-019. Washington, D.C.: U.S. Government Printing Office.

EPA. 1982. "Handbook for Sampling and Sample Preservation of Water and Wastewater." U.S. Environmental Protection Agency report EPA-600/4-82-029. Washington, D.C.: U.S. Government Printing Office.

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EPA. 1983. "Manual of Groundwater Quality Sampling Procedures." U.S. Environmental Protection Agency report EPA/600/2-81-160. Washington, D.C.: U.S. Government Printing Office.

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EPA. 1985. "Practical Guide for Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

EPA. 1986. "RCRA Groundwater Monitoring Technical Enforcement Guidance Document." U.S. Environmental Protection Agency document OSWER-9950.1. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Recommendation for Sampling and Preservation of Water Samples According to Measurement

5.3. Sampling and Preservation Procedures for RCRA Groundwater Detection Monitoring

5.4. Analysis Plan for Soil/Sediment Samples

5.5. Sample Containers for Waste

5.6. Containers for Aqueous Waste Samples

5.7. Analysis Plan for Soil/Sediment/Waste Samples

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Narrow-mouth amber glass bottles with Teflon-lined caps (0.5, 1, and 2 liters)

_____ Amber glass vials with Teflon septa (40-ml)

_____ Blue Ice or equivalent

_____ 250-ml sterile bottle

_____ Cardboard boxes

_____ Insulated coolers

_____ Ballpoint pen (permanent black ink)

_____ Felt-tip marker pen (permanent black ink)

_____ Heavy-duty poly bags and ties

_____ Strapping tape

_____ Wide-mouth polyethylene bottles (0.5, 1, and 2 liters)

_____ Plastic trashcan liners

_____ 1-11 pH indicator paper

_____ Canvas bags

_____ Hach field test kit for sulfides

_____ Hach field test kit for chlorine

_____ Parafilm

_____ Ascorbic acid crystals

_____ Disposable surgical gloves (latex, PVC, other suitable plastic, or rubber)

_____ NaOH pellets

_____ Disposable wipes

_____ Crystalline $Na_2S_2O_3$

_____ Methanol and deionized water in Teflon wash bottles

APPENDIX 5.1, Continued

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Padding for packaging of samples

_____ Concentrated HNO_3, H_2SO_4, and HCl

_____ New or cleaned polyethylene narrow-mouth bottles (1.0 liter, 500 ml, 125 ml, and 60 ml)

APPENDIX 5.2

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
Physical Properties				
Color	50	P,G	Ice	48 Hrs.
Conductance	100	P,G	Ice	28 Days
Hardness	100	P,G	HNO_3 to pH<2	6 Mos.
Odor	200	G only	Ice	24 Hrs.
pH	25	P,G	None Required	Analyze Immediately
Residue				
Filterable	100	P,G	Ice	7 Days
Nonfilterable	100	P,G	Ice	7 Days
Total	100	P,G	Ice	7 Days
Volatile	100	P,G	Ice	7 Days
Settleable Matter	1000	P,G	Ice	48 Hrs.
Temperature	1000	P,G	None Required	Analyze Immediately
Turbidity	100	P,G	Ice	48 Hrs.
Metals				
Dissolved	200	P,G	Filter onsite HNO_3 to pH<2	6 Mos. 6 Mos.[8]
Total	100	P,G	HNO_3 to pH<2	6 Mos.
Chromium^{+6}	200	P,G	Ice	24 Hrs.

APPENDIX 5.2, Continued

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
Mercury				
Dissolved	100	P,G	Filter HNO_3 to pH<2	28 Days from date of collection
Total	100	P,G	HNO_3 to pH<2	28 Days
Inorganics, Nonmetallics				
Acidity	100	P,G	Ice	14 Days
Alkalinity	100	P,G	Ice	14 Days
Bromide	100	P,G	None Required	28 Days
Cations	1,000	P	HNO_3 to pH<2	28 Days
Chloride	50	P,G	None Required	28 Days
Chlorine	200	P,G	None Required	Analyse Immediately
Cyanides	500	P,G	NaOH to pH>12	14 Days from date of collection
Fluoride	300	P,G	Ice	28 Days
Iodide	100	P,G	Ice	24 Hrs.
Nitrogen				
Ammonia	400	P,G	Ice H_2SO_4 to pH<2	28 Days
Kjeldahl, Total	500	P,G	Ice H_2SO_4 to pH<2	28 Days
Nitrate Plus Nitrite	100	P,G	Ice H_2SO_4 to pH<2	14 Days
Nitrate[9]	100	P,G	Ice	48 Hrs.
Nitrite	50	P,G	Ice	48 Hrs.

APPENDIX 5.2, Continued

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT(1)

Measurement	Volume Requirement (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
Dissolved Oxygen				
Probe	300	G bottle and top	None Required	Analyse Immediately
Winkler	300	G bottle and top and store in dark	Fix onsite	8 Hours
Phosphorus				
Orthophosphate, Dissolved	50	P,G	Filter onsite Ice	48 Hrs.
Hydrolysable	50	P,G	Ice H_2SO_4 to pH<2	28 Days
Total, Dissolved	50	P,G	Filter on site Ice H_2SO_4 to pH<2	24 Hrs.
Silicia	50	P only	Ice	28 Days
Sulfate	50	P,G	Ice	28 Days
Sulfide	50	P,G	Ice add 2 m liter sinc acetate plus NaOH to pH >9	7 Days
Sulfite	50	P,G	None Required	Analyse Immediately
Organics				
BOD	1000	P,G	Ice	48 Hrs.
COD	50	P,G	Ice H_2SO_4 to pH<2	28 Days
Oil & Grease	1000	P,G	Ice H_2SO_4 to pH<2	28 Days

APPENDIX 5.2, Continued

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT(1)

Measurement	Volume Requirement (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
Organic Carbon	25	P,G	Ice H_2SO_4 or HCl to pH<2	28 Days
Phenolics	500	G only	Ice H_2SO_4 to pH<2	28 Days
Cyanide	1000	P,G	Ice 40% NaOH to pH>12, 0.6 g Ascorbic Acid	14 Days from date of collection
Coliform, Fecal and Total	250	P,G	Ice Sterile	6 Hrs.
Oil and Grease	1000	G	Ice H_2SO_4 to pH<2	28 Days
Phenols	1000	G, Teflon-lined Cap	Ice	7 Days until extraction; 40 Days after extraction
Total Organic Halogen and Purgeable aromatics	40	G, Teflon-lined vial septum	Ice 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 Days
Purgeable aromatics	40	G, Teflon-lined septum	Ice 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 Days
Acrolein and acrylonitrile	1000	G, Teflon-lined septum	Ice 0.008% $Na_2S_2O_3$[6] HCl to pH<2	7 Days 14 days
Phenols	1000	G, Teflon-lined cap	Ice 0.008% $Na_2S_2O_3$[6]	7 days until extraction; 40 days after extraction

APPENDIX 5.2, Continued

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT(1)

Measurement	Volume Requirement (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
Bensindines	1000 m liter	G, Teflon-lined cap	Ice 0.008% $Na_2S_2O_3$[6]	7 Days until extraction; 40 days after extraction
Phthalate esters	1000 m liter	G, Teflon-lined cap	Ice 0.008% $Na_2S_2O_3$[6]	7 Days until extraction; 40 days after extraction
Nitrosamines	1000 m liter	G, Teflon-lined cap	Ice store in dark 0.008% $Na_2S_2O_3$[6] extraction	7 Days until extraction; 40 days after
Nitroaromatics and isophorone	1000 m liter	G, Teflon-lined cap	Ice	7 days until extraction; 40 days after extraction
Polynuclear aromatic hydrocarbons	1000 m liter	G, Teflon-lined cap	Ice	7 days until extraction; 40 days after extraction
Haloethers	1000 m liter	G, Teflon-lined cap	Ice	7 days until extraction; 40 days after extraction
Chlorinated hydrocarbons	1000 m liter	G, Teflon-lined cap	Ice	7 days until extraction; 40 days after extraction
TCDD	1000 m liter	G, Teflon-lined cap	Ice	7 days until extraction; 40 days after extraction

APPENDIX 5.2, Continued

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT[1]

Measurement	Volume Requirement (ml)	Container[2]	Preservative[3,4]	Holding Time[5]
Pesticides Tests				
Pesticides	1000 m liter	G, Teflon-lined cap	Ice	7 days from date of collection until extraction; 40 days after extraction
Radiological Tests				
Alpha, beta and radium	1000 m liter	P,G	HNO_3 to pH<2	6 mos.
Tritium	25 m liter	G	None	No limit
Isotopic Uranium	500 m liter	P	HNO_3 to pH<2	6 mos.
Sr-90	1000 m liter	P	HNO_3 to pH<2	6 mos.

[1]More specific instructions for preservation and sampling are found with each procedure described in this manual. A general discussion about sampling water and industrial wastewater may be found as ASTM, Part 31, p. 72-82 (1976) Method D-3370.

[2]Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

[3]Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at the time of collection. When use of an automated sample makes it impossible to preserve each aliquot, then samples may be preserved by keeping cool at 4°C until compositing and sample splitting is completed.

[4]When any sample is to be shipped by common carrier or sent through the United States mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering material for transportation is responsible for ensuring compliance. For the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following material: Hydrochloric acid (HCl) in water solutions at concentrations of 0.080% by weight or less, pH about 12.30 or less.

[5]Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permitted, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time and has received a variance from the regional administrator. Some samples may not be stable for a shorter time, if knowledge exists to show it is necessary to maintain sample stability.

[6]Should only be used in the presence of residual chlorine.

APPENDIX 5.2, Concluded

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF WATER SAMPLES ACCORDING TO MEASUREMENT(1)

[7]Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

[8]Samples should be filtered immediately onsite before adding preservative for dissolved metals.

[9]For samples from nonchlorinated drinking water supplies, concentrated H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analysed within 14 days.

APPENDIX 5.3

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

Parameter	Recommended Container[b]	Preservative[d]	Maximum Holding Time	Minimum Volume Required for Analysis
		Indicators of Groundwater Contamination[c]		
pH	T,P,G	Field determined	None	25 ml
Specific conductance	T,P,G	Field determine	None	100 ml
TOC	G, amber, T-lined cap[e]	Ice	28 days HCl to pH<2	4 x 15 ml
TOX	G, amber, T-lined septa or caps	Ice, add 1.1M sodium sulfite	7 days	4 x 15 ml
		Groundwater Quality Characteristics		
Chloride	T, P, G	Ice	28 days	50 ml
Iron Manganese Sodium	T, P	Field acidified to pH <2 with HNO_3	6 months	200 ml
Phenols	G	Ice/H_2SO_4 to pH <2	28 days	500 ml
Sulfate	T, P, G	Ice	28 days	50 ml
		EPA Interim Drinking Water Characteristics		
Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver	T, P	Total Metals Field acidified to pH <2 with HNO_3 Dissolved Metals 1. Field filtration (0.45 micron)	6 months 28 days	1000 ml
	G, Amber	2. Acidify to pH <2 with HNO_3	6 months	1000 ml

APPENDIX 5.3, Continued

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

Parameter	Recommended Container[b]	Preservative	Maximum Holding Time	Minimum Volume Required for Analysis
Fluoride	T, P	Ice	28 days	300 ml
Nitrate/ Nitrite	T, P, G	Ice/H_2SO_4 to pH <2	14 days	1000 ml
Endrin Lindane Methoxychlor Toxaphene 2,4 D 2,4,5 TP Silvex	T, G	Ice	7 days	2000 ml
Radium Gross Alpha Gross Beta	P, G	Field acidified to pH <2 with HNO_3	6 months	1 gallon
Coliform bacteria	PP, G (sterilized)	Ice	6 hours	200 ml
		Other Groundwater Characteristics of Interest		
Cyanide	P, G	Ice, NaOH to pH >12. 0.6 g ascorbic acid[f,g]	14 days from date of collection	500 ml
Oil and Grease	G only	Ice H_2SO_4 to pH <2	28 days	100 ml
Semivolatile, nonvolatile organics	T, G	Ice	7 days from date of collection until extraction; 40 days to analysis	60 ml
Volatiles	G, T-lined	Ice Ice and HCl to pH<2	7 days 14 days	60 ml

[a]References:

Test Methods for Evaluation Solid Waste - Physical/Chemical Methods, SW-846 (2nd edition, 1982).
Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.
Standard Methods for the Examination of Water and Wastewater, 16th edition (1985).

APPENDIX 5.3, Concluded

SAMPLING AND PRESERVATION PROCEDURES FOR RCRA GROUNDWATER DETECTION MONITORING[a]

[b]Container Types:

P = Plastic (polyethylene)
G = Glass
T = Fluorocarbon resins (PTFE, Teflon, FEP and PFA)
PP = Polypropylene

[c]Based on the requirements for detection monitoring (265.93), the owner/operator must collect a sufficient volume of groundwater to allow for the analysis of four separate replicates.

[d]Shipping containers (cooling chest with ice or ice pack) should be certified as to the 4°C temperature at the time of sample placement into these containers. Preservation of samples requires that the temperature of collected samples be adjusted to 4°C and maintained at 4°C upon placement of sample and during shipment. Field personnel will check the temperature in the container at the time of shipping and ice the samples to maintain a cool temperature during shipment. Maximum-minimum thermometers can be placed into the shipping chest to record temperature history. Chain-of-custody forms will include the temperature in the container at the time of shipment and delivery at the laboratory in addition to in-transit (maximum) temperature, if available.

[e]Do not allow any headspace in the container.

[f]Use ascorbic acid only in the presence of oxidizing agents.

[g]Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

APPENDIX 5.4

ANALYSIS PLAN FOR SOIL/SEDIMENT SAMPLES

Analyte*	Method	Sample Container	Sample Volume (g)	Preservations	Holding Time (days)
Volatile Organics	Ref. 2	40-ml vial (2) w/Teflon-lined silicon rubber septum	5	Ice	14 from date of of collection
Base/Neutral/Acid Extractable Organics	Ref. 3	Amber G, 1 L	10-30	Ice	7/40[2]
Organochlorine Pesticide/PCB	Ref. 4	Amber G, 1 L	10-30	Ice	7/40[2]
TAL Inorganic[1]	Ref. 5	P, G, 1 L	200	Ice	180 Mercury = 28 days from date of collection
Non-TAL Metals	SW-846	P, G, 1 L	200	Ice	180
Reactivity	Ref. 6	Amber G	---	Ice	N/A
Chloride	EPA 300.0[3]	G, 1 L	20	Ice	N/A
Sulfate	EPA 300.0[3]	G, 1 L	20	Ice	N/A
Nitrate	EPA 300.0[3]	G, 1 L	20	Ice	N/A
Cyanide	Ref. 1	G, 1 L	200	Ice	12
Hexavalent Chromium	S.M. 312b[4]	G, 1 L	100	Ice	1

[1]Includes cesium, molybdenum, and strontium, which are non-TAL metals, but are analyzed using the same methods.

[2]Extract within 7 days from date of collection; analysis within 40 days of extraction.

[3]Soil/sediments will be leached with Laboratory Reagent Water (20 g soil to 50 ml water) and water extract analysed using procedure in "Methods for Chemical Analysis of Water and Wastes," 1983; EPA 600/4-79-020.

[4]Soil/sediment will be leached with Laboratory Reagent Water (5 g soil and 100 ml of water) by shaking for 2 hours, and the water extract filtered and subsequently analysed. This is in accordance with method 312B in Standard Methods for Examination of Water and Wastewater, 16th Edition.

*The FSP or WP will define the actual suite of parameters to be analysed for specific samples.

APPENDIX 5.4, Continued

ANALYSIS PLAN FOR SOIL/SEDIMENT SAMPLES

Method References

Ref. 1. Method 9010 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 2. Method 8240 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 3. Method 8270 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington DC 20460, Revised September 1986.

Ref. 4. Method 8080 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 5. Method 6010 or 7000 Series Methods - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 6. Method 9010, 9030 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 7. Method 1310 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

APPENDIX 5.5

SAMPLE CONTAINERS FOR WASTE

Waste Type	Recommended Container	Closure	Analysis
Photosensitive wastes 1000 or 2000 m liter	Amber HDPE or amber glass caps with Teflon liners for glass bottles	LPE caps for HDPE bottles; Bakelite	Waste characterization per 40 CFR-Part 261
Pesticide hydrocarbon chlorinated hydrocarbons petroleum distillates	Wide-mouth borosilicate glass bottles 1000 or 2000 ml	Bakelite caps with Teflon liner	Waste characterization per 40 CFR-Part 261
Oil wastes	HDPE bottles wide mouth 1000 or 2000 ml	LPE caps	Waste characterisation per 40 CFR-Part 261
Strong alkali or hydrofluoric acid	HDPE bottle, wide mouth 1000 ml	LPE caps	Waste characterization per 40 CFR-Part 261
Aqueous wastes-- characterisation of organics	Borosilicate glass bottles 1000 or 2000 ml	Caps with Teflon liner	Waste characterisation per 40 CFR-Part 261
Solids (sludge, soils, and granular)	8-os, wide-mouth glass bottle	Bakelite caps with Teflon liners	Waste characterisation per 40 CFR-Part 261

APPENDIX 5.6

CONTAINERS FOR AQUEOUS WASTE SAMPLES

Analyte*	Sample Container	Sample Volume	Preservation[7]	Holding Time(days)
TCL Volatile	40 ml vial (2)	40 ml	HCl pH<2 with HCl	14 from date of collection
TCL Base/Neutral/Acid[1]	Amber G, 1L	1 L	Ice	7/40[5]
TCL Pesticide/PCB	Amber G, 1L	1 L	Ice	7/40[5]
TAL Inorganic[2]	P,G, 1L	1 L	pH<2,w/HNO_3[6]	180 (Mercury = 28 days from date of collection)
Non-TAL Metals	P,G, 1L	1 L	pH<2,w/HNO_3[6]	180
Cyanide	P,G, 1L	0.5L	pH>12,w/NaOH	14 from date of collection
pH[3]	P,G	N/A	None	Field Meas.
Sp. Conductivity[3]	P,G	N/A	None	Field Meas.
Temperature[3]	P,G	N/A	None	Field Meas.
Diss. Oxygen[3]	G	N/A	None	Field Meas.
TDS	P,G 1L	0.1 L	Ice	7
TSS	P,G 1L	0.1 L	Ice	7
Total Phosphate	P,G, 1L	1L	Ice, pH<2[6]	28
Chloride, Sulfate	P,G, 1L	1 L	Ice	28
Carbonate/Bicarbonate[4]	P,G, 1L	1 L	Ice	14
Nitrate	P,G, 1L	1L	Ice	2
Hexavalent Chromium	P,G, 1L	1 L	Ice	2

[1]The HSL Base/Neutral/Acid fractions analytical parameters are the TCL semivolatiles.
[2]Includes Cesium, Molybdenum, and Strontium, which are non-TAL metals, but are analysed using the same methods.
[3]Field Measurements are collected at time of sampling.
[4]These are reported as carbonate and biocarbonate alkalinity.
[5]Seven days from date of collection to extraction; analysis within 40 days of extraction.
[6]All samples with the exception of those for total metals will be filtered within 4 hours of sample collection and preservatives added to the filtrate as specified.
[7]All samples will be kept at 4°C after arrival at the laboratory.
*The FSP or WP will define the actual suite of parameters to be analysed for specific samples.

APPENDIX 5.7

ANALYSIS PLAN FOR SOIL/SEDIMENT/WASTE SAMPLES*

Analyte*	Sample Container	Sample Volume(g)	Preservations	Holding Time(days)
TCL Volatile	40 ml vial (2)	5	Ice	14 from date of collection
TCL Base/Neutral/Acid[1]	Amber G, 1 L	10-30	Ice	7/40[3]
TCL Pesticide/PCB	Amber G, 1 L	10-30	Ice	7/40[3]
TAL Inorganic[2]	P,G; 1 L	200	Ice	180
Non-TAL Metals	P,G, 1L	200	Ice	180 (Mercury = 28 days from date of collection)
TCLP	Amber G	100	Ice	14 days
Chloride	G, 1 L[4]	20	Ice	28
Sulfate	G, 1 L[4]	20	Ice	28
Nitrate	G, 1 L[4]	20	Ice	28
Cyanide	G, 1 L	200	Ice	12
Hexavalent Chromium	G, 1 L[5]	200	Ice	1

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[1]The HSL Base/Neutral/Acid fractions analytical parameters are the TCL semivolatiles.

[2]Includes Cesium, Molybdenum, and Strontium, which are non-TAL metals.

[3]Extract within 7 days from date of collection; analysis within 40 days of extraction.

[4]Soil/sediments will be leached with laboratory reagent water (20 g soil to 50 m liter water) and water extract analysed using referenced procedure. Procedure reference: Methods for Chemical Analysis of Water and Wastes, 1983; EPA 600/4-79-020.

[5]Soil/sediment will be leached with laboratory reagent water (5 g soil and 100 m liter of water) by shaking for 2 hours. The water extract is filtered and subsequently analysed. This is in accordance with method 312B in Standard Methods for Examination of Water and Wastewater, 15th Edition.

*The FSP or WP Sampling Plans will define the actual suite of parameters to be analysed for specific samples.

APPENDIX 5.7, Continued

ANALYSIS PLAN FOR SOIL/SEDIMENT/WASTE SAMPLES

Method References

Ref. 1. Method 9010 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 2. Method 8240 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 3. Method 8270 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 4. Method 8080 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 5. Method 6010 or 7000 Series Methods - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 6. Method 9010 or 9030 Series Methods - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

Ref. 7. Method 1310 - "Test Methods for Evaluating Solid Wastes," Office of Solid Waste and Emergency Response, Washington, DC 20460, Revised September 1986.

STANDARD OPERATING PROCEDURE 1.5

GUIDE TO THE HANDLING, PACKAGING, AND SHIPPING OF SAMPLES

1. PURPOSE

To provide a general guide for packaging and shipping samples of environmental and hazardous materials to the laboratory. In addition, instructions are provided to select the correct category for packaging and shipping samples of unknown contents.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information concerning the scope and details of a specific operation. Refer to the FSP or WP for the type of samples to be collected and the destination for the samples. This SOP describes the procedures used by the ER Program technical assistance subcontractor when handling, packaging, and shipping samples. Other procedures or requirements used by installation subcontractors must conform to this SOP. The transportation of samples must protect the integrity of the sample and prevent any detrimental effects from the potentially hazardous nature of the samples.

Samples collected at a site are classified as environmental or hazardous material samples. In general, environmental samples are collected from streams, farm ponds, small lakes, wells, and offsite soils that are not expected to be contaminated with hazardous materials. Samples of onsite soils or water and materials collected from drums, bulk storage tanks, obviously contaminated ponds, impoundments, lagoons, pools, and leachates from hazardous waste sites are considered samples of hazardous materials. A distinction must be made between the two types of samples for two reasons.

1. The appropriate Department of Transportation (DOT) or International Air Transport Association (IATA) procedures for the transportation of samples must be determined. If there is any doubt, a sample should be considered hazardous and shipped accordingly.

2. The health and safety of laboratory personnel receiving samples must be protected. Special precautions are used at laboratories when samples that are not environmental are received.

Hazardous materials defined by the transportation regulations contained in 49 CFR (Subchapter C, Part 171) or the current edition of IATA regulations for dangerous goods (Sections 3 and 4) should be shipped only by the method of transportation specified in these regulations. Overnight shipments by air (Federal Express, for example) are governed by the IATA regulations. Transportation of hazardous materials exclusively by surface route is governed by the requirements of 49 CFR. This operating practice ensures compliance with the appropriate regulations and at times requires the implementation of packaging instructions that are more conservative and stringent than those required by regulation. Employees should be aware that regulatory bodies with jurisdiction have the authority to levy substantial fines and penalties to violators. Failure on the part

of any employee to follow the requirements of these procedures is cause for disciplinary action, including discharge.

This SOP provides general guidance for packaging, marking, labeling, and shipping samples of environmental and hazardous materials and should not be misconstrued as the equivalent of or replacement for the DOT or IATA regulations. When shipping any potentially hazardous samples, the DOT regulations (49 CFR 171-178) and IATA regulations must be followed. This SOP should be used in conjunction with DOT and IATA regulations and advice from the freight carrier to ensure that all regulations governing transportation are being followed.

Any questions about the instructions for shipping environmental samples or hazardous materials in this SOP should be directed to the subcontractor's health and safety officer, who provides technical assistance to the ER Program.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, SOPs 1.1-1.10 must be reviewed. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

E. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

C. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.3. Operation

Procedures for shipping samples under DOT and IATA regulations are provided in Appendixes 5.1 through 5.4. The following step-by-step procedure will ensure that all applicable requirements for classifying, packing, marking, labeling, and documenting samples can be met.

A. Determine the correct technical name or composition of substances that might be in the samples. Check to see if the substance is forbidden on aircraft. Section 1 of the IATA regulations for dangerous goods contains a list of the substances that cannot be transported by air.

B. All samples must be transported by cargo aircraft or land transport. See Appendixes 5.1 through 5.4 for the appropriate DOT and IATA requirements.

C. Consult the DOT or IATA references to select the appropriate shipping container and packing material.

D. Prepare the consignment according to relevant requirements.

E. Ensure that all appropriate markings are printed on the packages and labels are attached.

F. Make any appropriate advance arrangements with the carrier and obtain current information about regulations and specifications that might affect the shipment.

G. Prepare the cargo airbill, complete, and sign the appropriate declarations for transporting dangerous goods.

H. Deliver the shipment to the local office of the freight carrier or arrange for a pickup at the site. Do not seal the container until the freight carrier is satisfied that the internal packaging meets all applicable regulations.

I. Ensure that all chain-of-custody procedures are observed. The copy of the bill of lading form will be retained as evidence of the chain-of-custody transfer.

3.4. Postoperation

3.4.1. Field

A. When transferring the samples, have the transferee sign and record the date and time on the Custody Transfer Record/Lab Work Request form (see SOP 1.3, Sample Control and Documentation). Custody transfers made to a sample custodian in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody should fill in the appropriate section of the Custody Transfer Record/Lab Work Request form. Minimize the time of possession.

B. The field custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory. This responsibility includes completing, dating, and signing the appropriate portion of the Custody Transfer Record/Lab Work Request form. When samples of hazardous materials are shipped to a laboratory, provide advance notice.

C. Verify that all sample bottles have been correctly identified and labels include necessary information (for example, location, time, and date).

3.4.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. As in any other activity that may be used to support litigation, regulatory agencies must be able to provide the chain of possession and custody of any samples that are offered for evidence or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever samples for evidence are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate, written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and the introduction as evidence.

   A sample is in someone's custody under any of the conditions listed below.

   - It is in one's actual possession.
   - It is in one's view (after being in one's physical possession).
   - It is one's physical possession and then locked up so that no one can tamper with it.
   - It is kept in a secured area that is restricted to only authorized personnel.

C. Send all packages to the laboratory with the Custody Transfer Record/Lab Work Request form and other pertinent forms. Retain a copy of these forms at the originating office (either carbon or photocopy). Register mailed packages with a return receipt requested. For packages sent by common carrier, retain receipts as part of the permanent chain-of-custody documentation. Pack samples to eliminate the possibility of

breakage during shipment. Seal or lock the package so that any tampering can be readily detected.

D. Additional guidelines for chain of custody, a sample of the form, and instructions for completing the Custody Transfer Record/Lab Work Request form are included in SOP 1.3, Sample Control and Documentation.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

International Air Transport Association. 1988. Dangerous Goods Regulations. January 1988. Montreal, Quebec, Canada.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transportation, Parts 100-199. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1 Environmental Samples

5.2 Samples of Hazardous and Radioactive Materials

5.3 Transportation of Unknown Hazardous Materials by 49 CFR

5.4 Transportation of Unknown Hazardous Materials by IATA

APPENDIX 5.1

ENVIRONMENTAL SAMPLES

A. Environmental Samples

Environmental samples may be packaged and shipped according to the following procedures.

B. Packaging

Before any samples are placed in their final shipping containers, the exterior of the sample containers should be wiped clean with a damp cloth. Environmental samples must then be packaged according to the following procedures.

1. Place sample container, properly labeled and with a chain-of-custody seal on a sealed lid, into a polyethylene bag and seal the bag.

2. Place sample in a fiberboard container approved by the Department of Transportation (DOT) or picnic cooler.

3. Pack container with enough noncombustible, absorbent cushioning material to minimize the possibility of breakage and absorb any materials that may have leaked from the sample jars. Vermiculite is recommended.

4. If there are multiple samples, be sure there is sufficient cushioning material between the sample containers (each in its individual polyethylene bag) to prevent breakage from dropping or severe shock.

5. Sealed bags of ice are packed with the samples to obtain 4°C.

6. Tape a sealed plastic bag containing the completed chain-of-custody form to the inside of the shipping container lid.

7. Seal outside container with duct tape or strapping tape.

8. On each side of the shipping container, place a signed chain-of-custody seal at the junction between the shipping container and lid.

C. Marking/Labeling

Sample containers must have a completed sample identification tag (see SOP 1.3, Sample Control and Documentation), and the outside container must be marked Environmental Sample. The appropriate side of the container must be marked This End Up, and arrow labels should be used accordingly. No DOT placards or labeling are required. Assure that all sample containers are labeled identically to labels on the shipping container.

D. Shipping Papers

No DOT or International Air Transport Association (IATA) shipping papers are required for environmental samples.

ENVIRONMENTAL SAMPLES

E. Transportation

There are no DOT or IATA restrictions on the mode of transportation for environmental samples. An overnight carrier is required.

F. Additional guidelines for water samples

Additional guidelines for the shipment of water samples is given in the TEGD. These include the following activities.

1. When the samples are placed in the shipping cooler, record the internal temperature of the cooler on the chain-of-custody form.

2. To determine the maximum and minimum temperature during shipment, place a thermometer that measures and records the maximum and minimum temperature range inside the shipping cooler.

3. Make sure that signed and dated chain-of-custody seals are present on the cap of each individual sample container and on the lid of the shipping cooler.

4. The internal temperature of the shipping container will be measured using a laboratory grade thermometer upon opening the cooler at the contracted laboratory.

APPENDIX 5.2

SAMPLES OF HAZARDOUS AND RADIOACTIVE MATERIALS

A. Samples of Hazardous Material

Samples that are not environmental samples or samples known or expected to contain hazardous substances must be considered samples of hazardous material and transported according to the following requirements.

If the hazardous material in the sample is known or can be accurately identified, it is packaged, marked, labeled, and shipped according to the specific instructions for that material described in the Department of Transportation Hazardous Materials Table (49 CFR 72.101) or the latest edition of the International Air Transport Association Dangerous Goods Regulations.

B. Samples of Radioactive Materials

Samples containing greater than 2,000 pCi/g of any radionuclide are considered to be radioactive materials by DOT (49 CFR 173.403y) and must be shipped following the requirements given in 49 CFR 173 for labeling and packaging. Table V.1 summarizes the shipping categories and concentration limits for several radionuclides commonly encountered during investigations. The labeling and packaging requirements for these categories are given in 49 CFR 172 subparts D and E.

TABLE V.1

RADIOACTIVE SAMPLE SHIPMENT REQUIREMENTS

Radionuclide	49 CFR Reference	Concentration	Total Quantity	DOT Class
Tritium in water				
	49 CFR 173.403(y)	<2 μCi/L	NA	Environmental
	49 CFR 173.423	2 μCi/L to 1 x 10^5 μCi/L	<1,000 Ci/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n)	1 x 10^5 μCi/L to 5 x 10^6 μCi/L	<1,000 Ci/ package	UN2912 (LSA)
Plutonium-238 in soil or other solids				
	49 CFR 173.403(y)	0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.423	0.002 μCi/g to 0.1 μCi/g	<30 μCi/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n) 49 CFR 173.435	0.002 μCi/g to 0.1 μCi/g	30 μCi to 3,000 μCi/ package	UN2912 (LSA)
Thorium-232 soil or other solids				
	49 CFR 173.403(y)	<0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.435	0.002 μCi/g to 300 μCi/g	Unlimited	UN2910 (Limited quantity)
Thorium-230 in soil or other solids				
	49 CFR 173.403(y)	<0.002 μCi/g	NA	Environmental
	49 CFR 173.403 49 CFR 173.423	0.002 μCi/g to 0.1 μCi/g	<30 μCi/ package	UN2910 (Limited quantity)
	49 CFR 173.403(n) 49 CFR 173.435	0.002 μCi/g to 0.1 μCi/g	30 μCi to 3,000 μCi/ package	UN2912 (LSA)

[a]The package refers to the shipment cooler (not the sample jars).
DOT - U.S. Department of Transportation
NA - not applicable
LSA - low-specific activity

APPENDIX 5.3

TRANSPORTATION OF UNKNOWN HAZARDOUS MATERIALS BY 49 CFR

A. Transportation of Unknown Hazardous Materials by 49 CFR

1. For samples of hazardous substances of unknown content that will be shipped by surface carrier under 49 CFR Transportation Regulations, the appropriate transportation category is selected through a process of elimination using the Department of Transportation (DOT) Hazardous Materials Classification system. While it is probable that most unknown samples of hazardous material shipped by field personnel will not contain radioactive materials or Poison A materials, it is essential for the following gradient hierarchy to be considered.

2. If radiation survey instruments demonstrate (or reasonable probability exists) that the unknown hazardous sample is radioactive, the appropriate DOT shipping regulations for radioactive material must be followed. Contact the subcontractor's health and safety officer for ER Program technical assistance for specific details.

3. If radioactive material is eliminated, the sample must then be considered to contain Poison A materials. DOT defines Poison A as an extremely dangerous, poisonous gas or a gas or liquid of the nature that a very small amount of gas (or vapor of the liquid) will be dangerous to life. Most Poison A materials are gases and would not be found in glass or drum-like containers. All samples taken from closed containers do not have to be shipped as Poison As. Based upon information available, judgment must be made as to whether a sample from a closed container is a Poison A. For specific instructions on the proper procedures for shipping Poison A, contact the subcontractor's health and safety officer for ER Program technical assistance.

4. If Poison A is eliminated as a shipment category, the next two classifications are flammable or nonflammable gases. Because an open container is not expected to contain a significant amount of gas, flammable liquid would be the next applicable category. After the categories of radioactive material, Poison A flammable gas, and nonflammable gas have been eliminated, the sample can be classified as a flammable liquid and shipped accordingly.

5. These procedures would also suffice for shipping any other samples classified below Poison A in the DOT classification table.

6. These procedures would also suffice for shipping any other samples classified below flammable liquids in the DOT classification table.

B. Shipment of Flammable Liquid by 49 CFR

The following instructions apply to the shipment of a flammable liquid by rail car, truck, or other common carrier.

1. Collect the sample in a glass or polyethylene container with a metallic, Teflon-lined screw cap. The container may be no larger than 16 fluid oz. To prevent leakage, fill the container no more than 90% full. Mark the fluid level on the outside of the sample container. If an air space in the sample container would affect sample integrity (for example, the case of a volatile organics analysis vial), place that container within a second container to meet the 90% requirement. Before any samples are placed in the final shipping container, the exterior should be wiped clean with a detergent solution.

2. Complete the sample identification tag (see SOP 1.3, Sample Control and Documentation) and attach it securely to the sample container. The sample identification tag should contain information needed to trace the sample to its point of origin and sample taker, as well as any quality assurance/quality control information.

3. Seal the container and place it in a 2-ml-thick (or thicker) polyethylene bag with one sample in each bag. Position the identification tag so that it can be read through the bag. Seal the bag.

4. Place the sealed bag inside a metal can and cushion it with enough noncombustible, absorbent material (for example, vermiculite) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to secure the lid onto the can.

5. Place one or more metal cans into a strong outside container (like a picnic cooler or a DOT-approved fiberboard box). Surround cans with noncombustible, absorbent cushioning material for stability during transport. Total sample volume in the picnic cooler or fiberboard box should not exceed 10 gallons. A separate air bill and shipping declaration must be processed for each container or combination of containers so that the total sample volume on any air bill will not exceed 10 gallons.

C. Shipment by Land

The following instructions apply for shipment of samples of hazardous material by car or truck (not by common carrier).

1. The above instructions for flammable liquids will apply.

2. Additionally, sample containers must be firmly secured so that they will not bounce against the sides of the vehicle during transit or in an accident.

3. Limit shipments to 1000 lbs or less. Under 1000 lbs, there are no placarding requirements under 49 CFR 172.504 (c) (1).

D. Chain of Custody

Include the Custody Transfer Record/Lab Work Request form (properly executed) in the outside container. It is also recommended to use chain-of-custody tape over each can lid.

E. Marking and Labeling Samples Classified as Flammable Liquid

1. Use abbreviations only where specified.

2. Place the information listed below on each paint can.

   - Laboratory name and address

   - Flammable Liquid, N.O.S. UN 1993. The designation N.O.S. means not otherwise specified. Use an approved DOT label.

3. Information placed on cans should also be placed on at least one side of the outside shipping containers. If labelling is placed on more than one side, it must be attached to all visible sides.

F. Shipping Papers for Samples Classified as Flammable Liquid

Shipping papers must be provided for the shipment of all samples (including those transported by rental, government, company, or personal cars).

G. Bill of Lading/Certification Statement

Complete the bill of lading and sign the certification statement. If the carrier does not provide it, use a standard industry form. Provide the information listed below in the order listed. One form may be used for more than one outside container.

- Flammable Liquid, N.O.S. UN 1993

- Limited Quantity (or Ltd. Qty.)

- Net weight or net volume (weight or volume may be abbreviated) just before or after the UN or ID number.

- Further description (like Laboratory Samples) is allowed if it does not contradict required information.

H. Transportation

1. Transport samples of unknown hazardous material that are classified as flammable liquid by rented or common carrier truck or railroad, as appropriate.

2. Do not transport by any air transport system.

APPENDIX 5.4

TRANSPORTATION OF UNKNOWN HAZARDOUS MATERIAL BY IATA

A. Transportation of Unknown Hazardous Material by International Air Transport Association (IATA)

For samples containing unknown material that will be shipped by air carrier, the most appropriate classification in the IATA regulations is the classification of other regulated substances. In order to use this designation, the categories shown below must be eliminated.

- Radioactive Materials
- Poison A Materials
- Flammable Gases
- Nonflammable Gases

B. Shipment of Other Regulated Substances

The instructions below will apply for the shipment of other regulated substances by cargo-carrying aircraft, rail car, or other common carrier.

1. Collect the sample in a glass or polyethylene container with a nonmetallic, Teflon-lined screw cap. The container may be no larger than 16 fluid oz. To prevent leakage, fill the container no more than 90% full. If an air space in the sample container would affect sample integrity (for example, the case of a volatile organics analysis vial), place that container within a second container to meet the 90% requirement. Before any samples are placed in the final shipping container, the exterior should be wiped clean with detergent solution.

2. Complete the sample identification tag (see SOP 1.3, Sample Control and Documentation) and attach it securely to the sample container. The sample identification tag should contain information needed to trace the sample to its point of origin and sample taker, as well as any quality assurance/quality control information.

3. Seal the container and place it in a 2-ml-thick (or thicker) polyethylene bag with one sample in each bag. Position the identification tag so that it can be read through the bag. Seal the bag.

4. Place the sealed bag inside a metal can and cushion it with enough noncombustible, absorbent material (for example, vermiculite) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to secure the lid onto the can.

5. Place one or more metal cans into a strong outside container (like a picnic cooler or a DOT-approved fiberboard box). Surround cans with noncombustible, absorbent cushioning material for stability during transport. Total sample volume in the picnic cooler or fiberboard box should not exceed 40 liters.

C. Chain of Custody

Include the Custody Transfer Record/Lab Work Request form (properly executed) in the outside container. It is also recommended to use chain-of-custody tape over each can lid.

D. Marking and Labeling Samples Classified as Other Regulated Substances

1. Use abbreviations only where specified.

2. Place the information listed below on each paint can.

   - Laboratory name and address

   - Other regulated substances, UN8027. Hazardous Class # 9

3. Information placed on cans should also be placed on at least one side of the outside shipping containers. If labelling is placed on more than one side, it must be attached to all visible sides.

4. Cargo Aircraft Only must be printed on all outside shipping containers.

5. Print Laboratory Samples and This End Up or This Side Up clearly on top of the outside shipping container. Outside containers also must contain the statement Inside Packages to Comply with Prescribed Specifications. Put upward pointing arrows on all four sides of the container.

E. Shipping Papers for Samples Classified as Other Regulated Substances

Shipping papers must be provided for the shipment of all samples (including those transported by rental, government, company, or personal cars).

F. Bill of Lading/Certification Statement

Complete the bill of lading and sign the certification statement. If the carrier does not provide it, use a standard industry form. Provide the information listed below in the order listed. One form may be used for more than one outside container.

- Other Regulated substances, UN8027

- Class or Division # 9

- Net weight or net volume (weight or volume may be abbreviated) just before or after the UN or ID number.

- Further description (like Laboratory Samples) is allowed if it does not contradict required information.

G. Transportation

1. Transport samples of unknown hazardous material that are classified as other regulated substances by rented or common carrier truck, railroad, express overnight package services, or other appropriate means.

2. Do not transport by any passenger-carrying air transport system. Ship by air carriers that transport only cargo (for example, Federal Express).

STANDARD OPERATING PROCEDURE 1.6

GENERAL EQUIPMENT DECONTAMINATION

1. PURPOSE

To describe methods for the decontamination of field equipment potentially contaminated during sample collection.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a given operation. The FSP or WP also contains specifications for the use of decontamination agents, areas where decontamination will be performed, and quality assurance procedures to verify the effectiveness of the decontamination procedures. Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross-contamination among samples and helps maintain a clean working environment for the safety of all field personnel.

Decontamination is mainly achieved by rinsing with liquids that include soap or detergent solutions, tap water, deionized water, and methanol. Equipment is allowed to air dry after being cleaned or wiped dry with chemical-free cloths or paper towels. It can then be reused immediately. Steam cleaning should be used whenever visible contamination exists or for large machinery/vehicles.

It is the primary responsibility of the site manager to assure that proper decontamination procedures are followed and that all waste materials produced are properly stored or disposed of. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that contaminants are not negligently introduced into the environment.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
6.4	Total Alpha Surface Contamination Measurements

6.11 Beta-Gamma Radiation Measurements Using a Geiger-Mueller Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1.

E. Notify the analytical laboratory of the decontamination blank sample and the approximate arrival date.

F. Contact the carrier that will transport the sample to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

A. Assemble containers and equipment for decontamination.

B. Decontaminate all equipment before use.

3.3. Operation

The extent of known contamination determines the extent to which equipment must be decontaminated. If the extent of contamination cannot be readily determined, clean the equipment on the assumption that it is highly contaminated until enough data are available to allow an accurate assessment of the level of contamination.

Adequate supplies of rinsing liquids and all materials should be available. Perform decontamination in the same level of protective clothing as sampling activities unless a different level of protection is specified in the FSP or Health and Safety Plan.

The procedure for full field decontamination follows. Any deviations from this procedure for a specific project are included in the FSP or WP.

Decontamination Steps

1. The purpose of the initial step is to remove gross contamination. Remove any solid particles from the equipment or material by brushing and then

rinsing with available tap water. For drilling equipment, steam cleaning is necessary.

2. Wash equipment with a nonphosphate soap or detergent solution, such as Alconox®.

3. Rinse with tap water by submerging or spraying.

4. For organic contaminants, rinse with methanol then hexane. Methanol must be of a laboratory-reagent grade and hexane a "pesticide" grade.

5. Rinse thoroughly with distilled water.

6. Air dry equipment or rinse with nanograde methanol to expedite drying.

7. If radiation screening is required by the FSP or WP, screen the equipment with a radiation detector according to SOP 6.4, Total Alpha Surface Contamination Measurements; or SOP 6.12, Radon-222 Flux Measurements Using Charcoal Canisters. If activity above the limits for unrestricted use is detected, repeat steps 1-6.

8. Samples of drippings from the last rinse in step 5 may be collected and analyzed to verify the effectiveness of the decontamination procedure. This type of sample is called a decontamination blank. The results of these analyses are not usually available for at least one week after they arrive in the laboratory, so it is important to do a thorough decontamination from the start of the sampling activity to minimize the potential for a positive hit in the decontamination drippings.

3.4. Postoperation

3.4.1. Field

A. Decontaminate as much sampling equipment as possible and properly dispose of expendable items that cannot be decontaminated. Proper disposal may involve onsite drumming of liquids and solids in approved containers for subsequent disposal. Expensive items like machinery may require a more advanced decontamination analysis.

B. Prepare the decontamination blank sample and transport it according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

C. Store containers of solutions produced during decontamination in a secure area.

D. Dispose of any soiled materials as designated in the FSP or WP.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of contamination attained.

3.4.3. Office

A. Deliver original logbooks to the site manager for technical review. He/she will review and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that the sample arrives safely and instructions for analyses are clearly understood.

D. After receiving the results of the laboratory analyses, arrange for the disposal of wastes generated during the investigation.

4. SOURCE

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Decontamination solutions preselected by the laboratory

_____ Cleaning liquids: soap or detergent solutions, tap water, deionized water, and methanol

_____ Chemical-free paper towels

_____ Cleaning brushes

_____ Cleaning containers: plastic buckets and galvanized steel pans

_____ Waste storage containers: drums and plastic bags

STANDARD OPERATING PROCEDURE 1.8

PERSONNEL DECONTAMINATION--LEVEL D PROTECTION

1. PURPOSE

To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level D protective clothing.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a specific operation. Refer to the FSP or WP Health and Safety Plan for recommendations about the level of protection worn to enter a site and the criteria for upgrading to higher levels of protection.

Level D protective clothing is primarily a work uniform. This level of protection is worn when work functions preclude splashes, immersion, inhalation, or exposure to materials above the action limits specified in the FSP or WP.

Although Level D protection is worn under these conditions, workers may be wearing disposable coveralls and gloves, safety boots/shoes, a hard hat, and safety glasses. Therefore, the site Health and Safety Plan must address the proper disposition of disposable clothing and decontamination measures that should be implemented. The disposition of disposable items must follow installation requirements and any applicable state and federal regulations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; documentation procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.9	Personnel Decontamination--Level C Protection

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. The FSP or WP Health and Safety Plan will specify the procedures and equipment required for the decontamination and disposal of Level D protective clothing. All onsite personnel will be informed about the proper disposal of protective clothing and any decontamination solutions used.

C. Appendix 5.1 lists the items suggested for Level D decontamination. This list provides general guidelines and can be modified in order to meet site-specific work activities or features.

D. Obtain necessary clothing, protective gear, and equipment. Read the Health and Safety Plan and ensure that necessary decontamination materials are available.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

Before initiating field activities, designate an area for decontamination activities. Although Level D areas should be minimally contaminated, always use caution to prevent the potential spread of any unknown contaminants.

3.3. Operation

The following decontamination procedures are recommended for Level D protection. These measures represent suggested guidelines and may be modified to meet site-specific conditions.

A. Remove any disposable coveralls, rubber gloves, and boot covers and place in a plastic trash sack.

B. If dusty conditions have been encountered, use water-dampened paper towels to remove the dust from hard hats and safety glasses/goggles. Place used paper towels in a trash sack.

C. If necessary, decontaminate safety boots with water and a steel brush. Do not wear muddy or dusty boots out of the exclusion zone.

D. All workers should wash hands and face before leaving the site.

E. All workers should change clothing and shower as soon as possible after the day's work activities.

3.4. Postoperation

3.4.1. Field

Collect all trash sacks containing disposable clothing. Dispose of trash sacks according to the requirements of the site Health and Safety Plan. The site manager or field team leader is responsible for the safe disposal of any items.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.4.3. Office

Return all unused items to the equipment manager. The equipment manager should be informed of all stock items that need to be ordered to replenish the inventory.

4. SOURCES

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG) and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Standard Operating Safety Guides." Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, November 1984. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Plastic trash sacks
30-gallon size: (no. of boxes) _____
20-gallon size: (no. of boxes) _____

_____ Plastic wash tub: (number) _____

_____ Paper towels: (no. of rolls)_____

_____ Liquid hand soap

_____ Wet wipe towelettes

_____ Water container
(size) 1 gallon_____ 5 gallon_____

_____ Brushes (scrub or wire)

_____ Alpha scintillation detector

STANDARD OPERATING PROCEDURE 1.9

PERSONNEL DECONTAMINATION--LEVEL C PROTECTION

1. PURPOSE

To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level C protective clothing.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information regarding the scope and details of a specific operation. Refer to the FSP or WP Health and Safety Plan for recommendations about the level of protection worn to enter a site and the criteria for upgrading or downgrading to other levels of protection.

Protective clothing and equipment must be worn by personnel when known or suspected hazardous substances are involved. The necessary equipment and procedures for decontaminating personnel in Level C protection are addressed in this SOP. The procedures include maximum and minimum decontamination measures.

The establishment of decontamination lines is site specific; these lines depend upon the types of contamination and the work performed. When the decontamination line is no longer required, contaminated wash and rinse solutions and articles must be contained and disposed of appropriately. Disposal must follow installation requirements and any applicable state and federal regulations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.8	Personnel Decontamination--Level D Protection

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. The selection of the appropriate level of personnel decontamination is site specific and is given in the site Health and Safety Plan. Coordinate any changes with the site health and safety coordinator. Considerations for selection include work activity, known or suspected contaminants, previous experience at the site, and health and safety requirements.

C. The site Health and Safety Plan should include details of the procedures for the ultimate disposal of protective clothing and waste water. The packaging and disposal procedures must be approved by the installation authorities responsible for waste disposal. Inform all onsite personnel about the proper disposal of protective clothing and decontamination solutions.

D. Appendix 5.1 includes recommendations for equipment and supplies used in maximum decontamination measures. Appendix 5.2 includes recommendations for equipment and supplies used in minimum decontamination measures. These appendixes contain general equipment guidelines. The selection of equipment must be site specific to incorporate unusual work activities or site features. Detailed information is in the FSP or WP.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.2.3. Field

A. Before field activities begin, establish site work zones to prevent the accidental spread of hazardous substances. The establishment of work zones is site specific and coordinated with the site health and safety coordinator at the time the Health and Safety Plan is prepared. Considerations for establishing work zones should include wind direction, weather conditions, emergency situations, changes in site activities, and access.

B. Appendix 5.3 shows an example of a maximum decontamination layout for Level C protection. Appendix 5.4 shows an example of the minimum decontamination layout for Level C protection.

NOTE: The layouts may be modified according to site-specific conditions.

3.3. Operation

3.3.1. Maximum Decontamination Measures

The maximum decontamination measures for Level C are described in Appendix 5.5. These measures are guidelines and may be modified according to site-specific conditions.

3.3.2. Modification of Maximum Decontamination Measures

Depending upon site-specific conditions and circumstances, modifications to the maximum decontamination measures may be permissible. Two example situations in which the maximum decontamination measures may be modified are described below.

A. Situation 1--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and safety boots are not contaminated.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1, 4 through 8, 10, 11, and 14 through 17.

B. Situation 2--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and safety boots are not contaminated. The individual needs a new canister or mask and will return to the exclusion zone.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1 and 4 through 9.

3.3.3. Minimum Decontamination Measures

The minimum decontamination measures for Level C are described in Appendix 5.6. These measures are guidelines and may be modified according to site-specific conditions.

3.4. Postoperation

3.4.1. Field

After the completion of field activities, all contaminated wash and rinse waters, decontamination solutions, and contaminated articles must be properly disposed of. The disposal methods must follow installation requirements. The site manager or field team leader is responsible for the safe disposal of contaminated materials. Planning for the proper disposal should be included during office preparation before field activities begin.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.4.3. Office

Return all unused or properly decontaminated equipment will be returned to the equipment manager. The equipment manager should be informed of all stock items that need to be ordered to replenish the inventory.

4. SOURCES

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Standard Operating Safety Guides." Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency document, November 1984. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies for Maximum Decontamination Measures for Level C

5.2. Equipment and Supplies for Minimum Decontamination Measure for Level C

5.3. Maximum Decontamination Layout for Level C Protection

5.4. Minimum Decontamination Layout for Level C Protection

5.5. Maximum Measures for Level C Decontamination

5.6. Minimum Measures for Level C Decontamination

APPENDIX 5.1

EQUIPMENT AND SUPPLIES FOR MAXIMUM DECONTAMINATION MEASURES FOR LEVEL C

Station 1:
a. Various Size Containers
b. Plastic Liners
c. Plastic Drop Cloths

Station 2:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
a. Containers (20-30 Gallons)
or
High-pressure Spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 4:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 5:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools

Station 6:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 7:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 8:
a. Containers (20-30 Gallons)
or
High-pressure spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 9:
a. Air Tanks or Face Masks and Cartridge, Depending on Level
b. Tape
c. Boot Covers
d. Gloves

Station 10:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools
d. Boot Jack

Station 11:
a. Rack
b. Drop Cloths
c. Bench or Stools

Station 12:
a. Table

Station 13:
a. Basin or Bucket
b. Decon Solution
c. Small Table

Station 14:
a. Water
b. Basin or Bucket
c. Small Table

Station 15:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 16:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 17:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 18:
a. Water
b. Soap
c. Small Table
d. Basin or Bucket
e. Field Showers
f. Towels

Station 19:
a. Dressing Trailer in Inclement Weather
b. Tables
c. Chairs
d. Lockers
e. Cloths

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.2

EQUIPMENT AND SUPPLIES FOR MINIMUM DECONTAMINATION MEASURES FOR LEVEL C

Station 1:
- a: Various Size Containers
- b. Plastic Liners
- c. Plastic Drop Cloths

Station 2:
- a. Containers (20-30 Gallons)
- b. Decon Solution
- c. Rinse Water
- d. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

Station 4:
- a. Air Tanks or Masks and Cartridges, Depending Upon
- b. Tape
- c. Boot Covers
- d. Gloves

Station 5:
- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

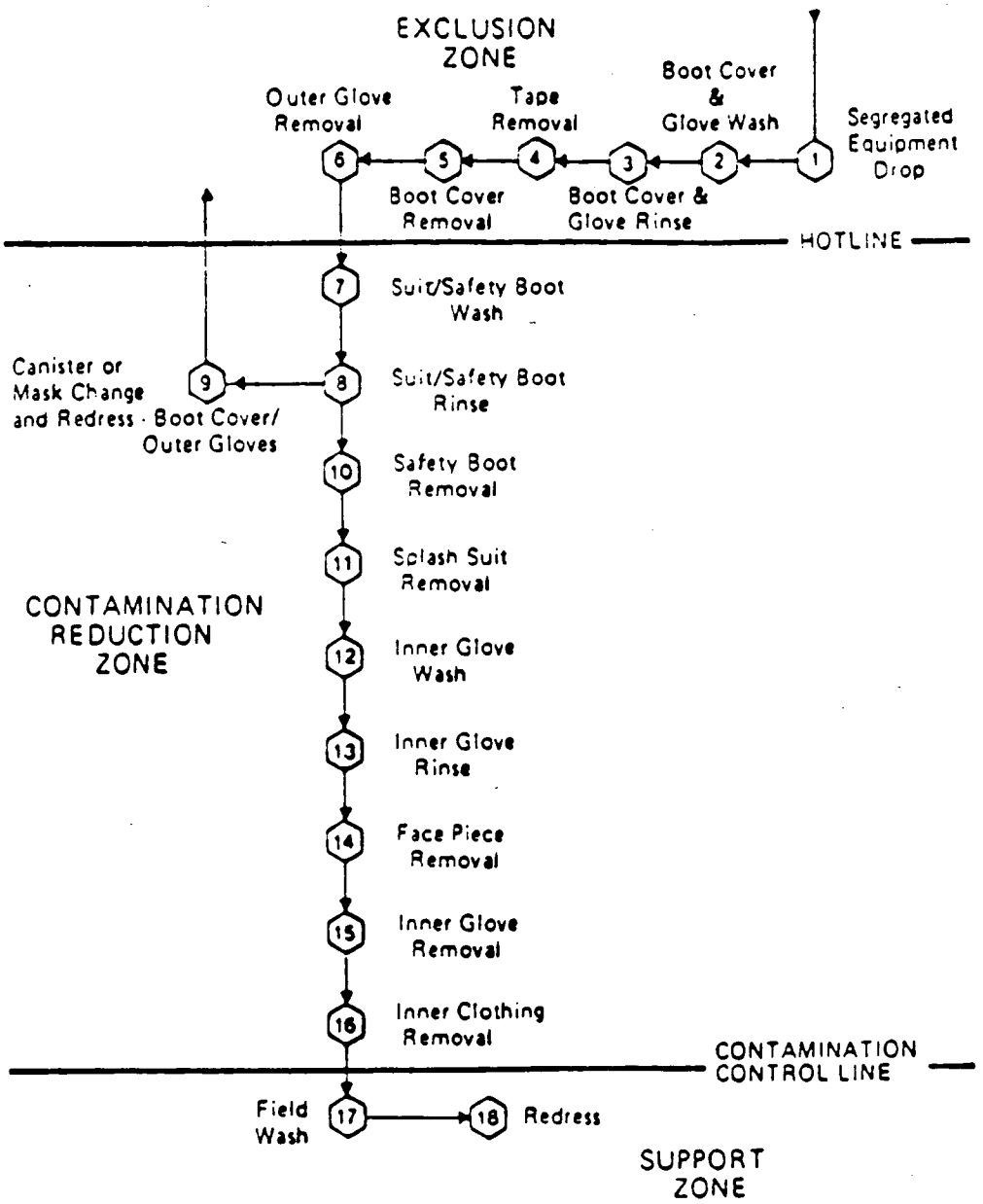
Station 6:
- a. Plastic Sheets
- b. Basin or Bucket
- c. Soap and Towels
- d. Bench or Stools

Station 7:
- a. Water
- b. Soap
- c. Tables
- d. Wash Basin or Bucket

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.3

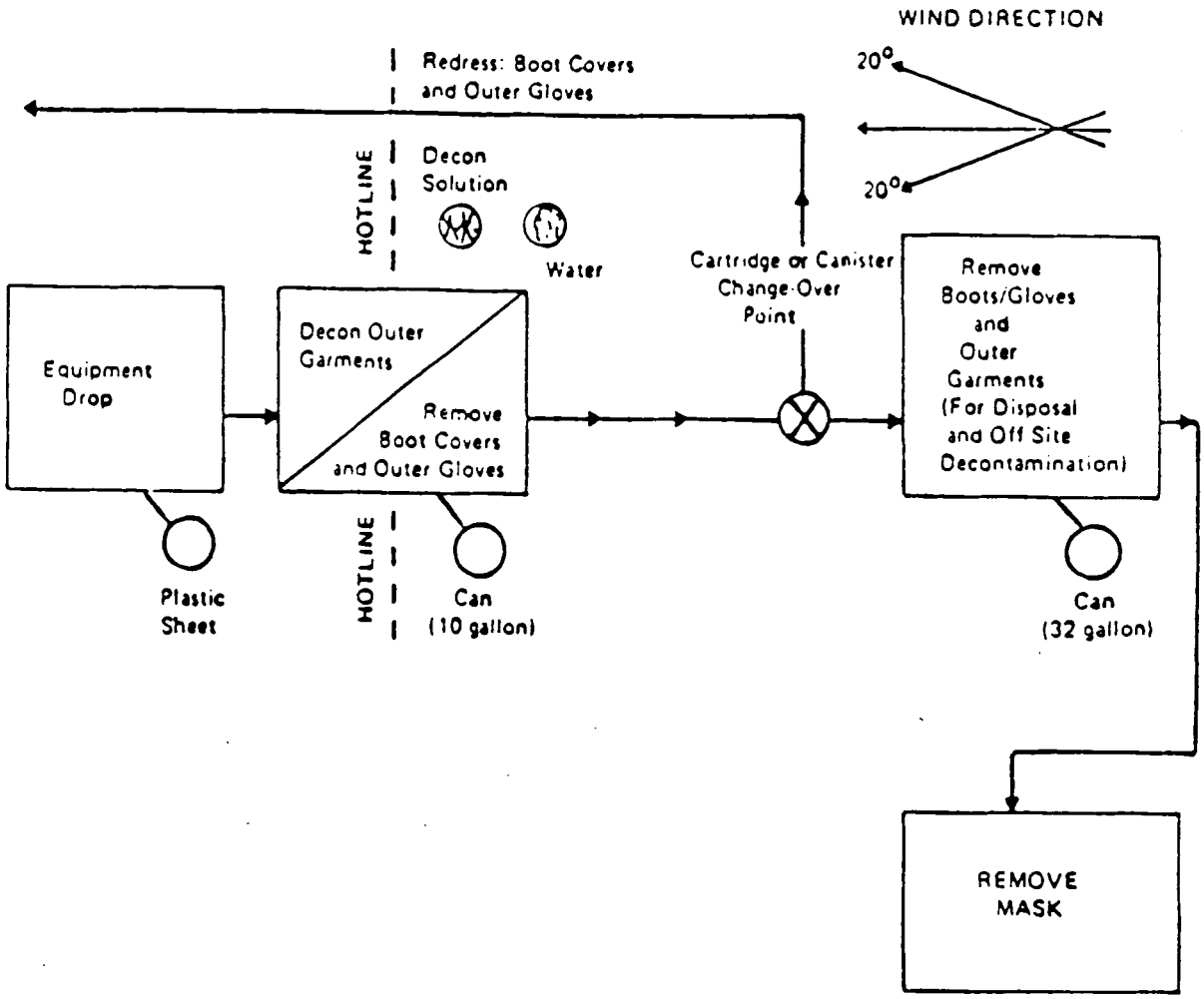
MAXIMUM DECONTAMINATION LAYOUT FOR LEVEL C PROTECTION



SOURCES: NIOSH, OSHA, USCG and EPA, October 1985
U.S. EPA, November 1985

APPENDIX 5.4

MINIMUM DECONTAMINATION LAYOUT FOR LEVEL C PROTECTION



SOURCES: NIOSH, OSHA, USCG and EPA, October 1985
U.S. EPA, November 1985

APPENDIX 5.5

MAXIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 1:	Segregated Equipment Drop	1. Deposit equipment used at the site (tools, sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths or in different containers with plastic liners. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Boot Cover and Glove Wash	2. Scrub outer boot covers and gloves with decon solution or detergent and water.
Station 3:	Boot Cover and Glove Rinse	3. Rinse off decon solution from station 2 using copious amounts of water.
Station 4:	Tape Removal	4. Remove tape around boots and gloves and deposit in container with plastic liner.
Station 5:	Boot Cover Removal	5. Remove boot covers and deposit in containers with plastic liner.
Station 6:	Outer Glove Removal	6. Remove outer gloves and deposit in container with plastic liner.
Station 7:	Suit and Boot Wash	7. Wash splash suit, gloves, and safety boots. Scrub with long-handled scrub brush and decon solution.
Station 8:	Suit and Boot and Glove Rinse	8. Rinse off decon solution using water. Repeat as many times as necessary.
Station 9:	Canister or Mask Change	9. If worker leaves exclusion sone to change canister (or mask), this is the last step in the decontamination procedure. The worker's canister is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.

APPENDIX 5.5, Continued

MAXIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 10:	Safety Boot Removal	10. Remove safety boots and deposit in container with plastic liner.
Station 11:	Splash Suit Removal	11. With assistance of helper, remove splash suit. Deposit in container with plastic liner.
Station 12:	Inner Glove Rinse	12. Wash inner gloves with decon solution.
Station 13:	Inner Glove Wash	13. Rinse inner gloves with water.
Station 14:	Face Piece Removal	14. Remove face piece. Deposit in container with plastic liner. Avoid touching face with fingers.
Station 15:	Inner Glove Removal	15. Remove inner gloves and deposit in lined container.
Station 16:	Inner Clothing Removal	16. Remove clothing soaked with perspiration and place in lined container. Do not wear inner clothing away from the site, because there is a possibility that small amounts of contaminants might have been transferred in removing the outer clothing. When applicable, begin a gross alpha contamination survey.
Station 17:	Field Wash	17. Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.
Station 18:	Redress	18. Put on clean clothes.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.6

MINIMUM MEASURES FOR LEVEL C DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used at the site (tools, sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves, and splash suit with decon solution or detergent water. Rinse off using water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Canister or Mask Change	4. If worker leaves exclusive zone to change canister (or mask), this is the last step in the decontamination procedure. The worker's canister is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.
Station 5:	Boots, Gloves, and Outer Garment Removal	5. Boots, chemical-resistant splash suit, and inner gloves are removed and deposited in separate containers lined with plastic.
Station 6:	Face Piece Removal	6. Face piece is removed. Avoid touching face with fingers. Face piece deposited on plastic sheet.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

STANDARD OPERATING PROCEDURE 1.10

PERSONNEL DECONTAMINATION--LEVEL B PROTECTION

1. PURPOSE

To describe the equipment and procedures required for decontamination of persons who have performed field activities in Level B protective clothing.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of a specific operation. Refer to the FSP or WP Health and Safety Plan for recommendations about the level of protection worn to enter a site and the criteria for upgrading or downgrading to other levels of protection.

Protective clothing and equipment must be worn by personnel when known or suspected hazardous substances are involved. The necessary equipment and procedures for decontaminating personnel in Level B protection are addressed in this SOP. The procedures include maximum and minimum decontamination measures.

The establishment of decontamination lines is site specific. These lines depend upon the types of contamination and the work performed. When the decontamination line is no longer required, contaminated wash and rinse solutions and articles must be contained and disposed of appropriately. Disposal must follow installation requirements and any applicable state and federal regulations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Other procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.8	Personnel Decontamination--Level D Protection
1.9	Personnel Decontamination--Level C Protection

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. The selection of the appropriate level of personnel decontamination is site specific and determined by the site health and safety coordinator. Consult the site Health and Safety Plan for the level of protection. Considerations for selection include work activity, known or suspected contaminants, previous experience at the site, and the installation of health and safety requirements specified by the facility's management company.

C. The site Health and Safety Plan should include details of the plans for ultimate disposal of protective clothing, waste water, and potentially contaminated articles. The packaging and disposal procedures must be approved by the installation authorities responsible for waste disposal. Inform all onsite personnel about the proper disposal of protective clothing and decontamination solutions.

D. Appendix 5.1 includes recommendations for equipment and supplies used in maximum decontamination measures. Appendix 5.2 includes recommendations for equipment and supplies used in minimum decontamination measures. These appendixes contain general equipment guidelines. The selection of equipment must be site specific to incorporate unusual work activities or site features. Detailed information is in the FSP or WP.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. There are no forms required to document decontamination procedures and the degree of documentation attained.

3.2.3. Field

A. Before field activities begin, establish site work zones to reduce the accidental spread of hazardous substances. The establishment of work zones is site specific and coordinated with the site health and safety coordinator at the time the site Health and Safety Plan is prepared. Considerations for establishing work zones should include wind direction, weather conditions, emergency situations, changes in site activities, and access.

B. Appendix 5.3 shows an example of a maximum decontamination layout for Level B protection. Appendix 5.4 shows an example of the minimal decontamination layout for Level B protection.

NOTE: These layouts may be modified according to site-specific conditions.

3.3. Operation

3.3.1. Maximum Decontamination Measures

The maximum decontamination measures for Level B are described in Appendix 5.5. These measures are guidelines and may be modified according to site-specific conditions.

3.3.2. Modification of Maximum Decontamination Measures

Depending upon site-specific conditions and circumstances, modifications to the maximum decontamination measures may be permissible. Two example situations in which the maximum decontamination measures may be modified are described below.

A. Situation 1--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and boots are not contaminated.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1, 4-8, 10-12, and 15-19.

B. Situation 2--The individual entering the contamination reduction zone is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. Outer gloves and boot covers are worn. The inner gloves and boots are not contaminated. The individual needs a new air tank and will return to the exclusion zone.

   The following decontamination stations described in Appendix 5.5 would be utilized in this situation: Station Numbers 1, and 4-9.

3.3.3. Minimum Decontamination Measures

The minimum decontamination measures for Level B are described in Appendix 5.6. These measures are only guidelines and may be modified according to site-specific conditions.

3.4. Postoperation

3.4.1. Field

At the completion of field activities, all contaminated wash and rinse water, decontamination solutions, and contaminated articles must be properly disposed of. The disposal must follow installation requirements and any applicable state and federal regulations. The site manager or field team leader is responsible for the safe disposal of contaminated materials. Planning for proper disposal should be included during office preparations before field activities begin.

3.4.2. Documentation

A. Record radiological measurements in the logbook before leaving the site.

B. There are no forms required to document decontamination procedures and the degree of decontamination attained.

3.4.3. Office

All unused or properly decontaminated equipment will be returned to the equipment manager. The equipment manager should be informed of all stock items that need to be ordered to replenish the inventory.

4. SOURCES

NIOSH, OSHA, USCG and EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Standard Operating Safety Guides", Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency document, November 1984. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies for Maximum Decontamination Measures for Level B

5.2. Equipment and Supplies for Minimum Decontamination Measures for Level B

5.3. Maximum Decontamination Layout for Level B Protection

5.4. Minimum Decontamination Layout for Level B Protection

5.5. Maximum Measures for Level B Decontamination

5.6. Minimum Measures for Level B Decontamination

APPENDIX 5.1

EQUIPMENT AND SUPPLIES FOR MAXIMUM DECONTAMINATION MEASURES FOR LEVEL B

Station 1:
a. Various Size Containers
b. Plastic Liners
c. Plastic Drop Cloths

Station 2:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
a. Containers (20-30 Gallons)
or
High-pressure Spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 4:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 5:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools

Station 6:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 7:
a. Containers (20-30 Gallons)
b. Decon Solution or Detergent Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 8:
a. Containers (20-30 Gallons)
or
High-pressure Spray Unit
b. Water
c. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 9:
a. Air Tanks
b. Tape
c. Boot Covers
d. Gloves

Station 10:
a. Containers (20-30 Gallons)
b. Plastic Liners
c. Bench or Stools
d. Boot Jack

Station 11:
a. Rack
b. Drop Cloths
c. Bench or Stools

Station 12:
a. Table

Station 13:
a. Basin or Bucket
b. Decon Solution
c. Small Table

Station 14:
a. Water
b. Basin or Bucket
c. Small Table

Station 15:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 16:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 17:
a. Containers (20-30 Gallons)
b. Plastic Liners

Station 18:
a. Water
b. Soap
c. Small Table
d. Basin or Bucket
e. Field Showers
f. Towels

Station 19:
a. Dressing Trailer Needed in Inclement Weather
b. Tables
c. Chairs
d. Lockers
e. Cloths

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.2

EQUIPMENT AND SUPPLIES FOR MINIMUM DECONTAMINATION MEASURES FOR LEVEL B

Station 1:
a. Various Size Containers
b. Plastic Liners
c. Plastic Drop Cloths

Station 2:
a. Containers (20-30 Gallons)
b. Decon Solution
c. Rinse Water
d. 2-3 Long-handled, Soft-bristled Scrub Brushes

Station 3:
a. Containers (20-30 Gallons)
b. Plastic Lines
c. Bench or Stools

Station 4:
a. Air Tanks or Masks and Cartridges, Depending Upon the Concentration and Types of Airborne Contamination
b. Tape
c. Boot Covers
d. Gloves

Station 5:
a. Containers
b. Plastic Liners
c. Bench or Stools

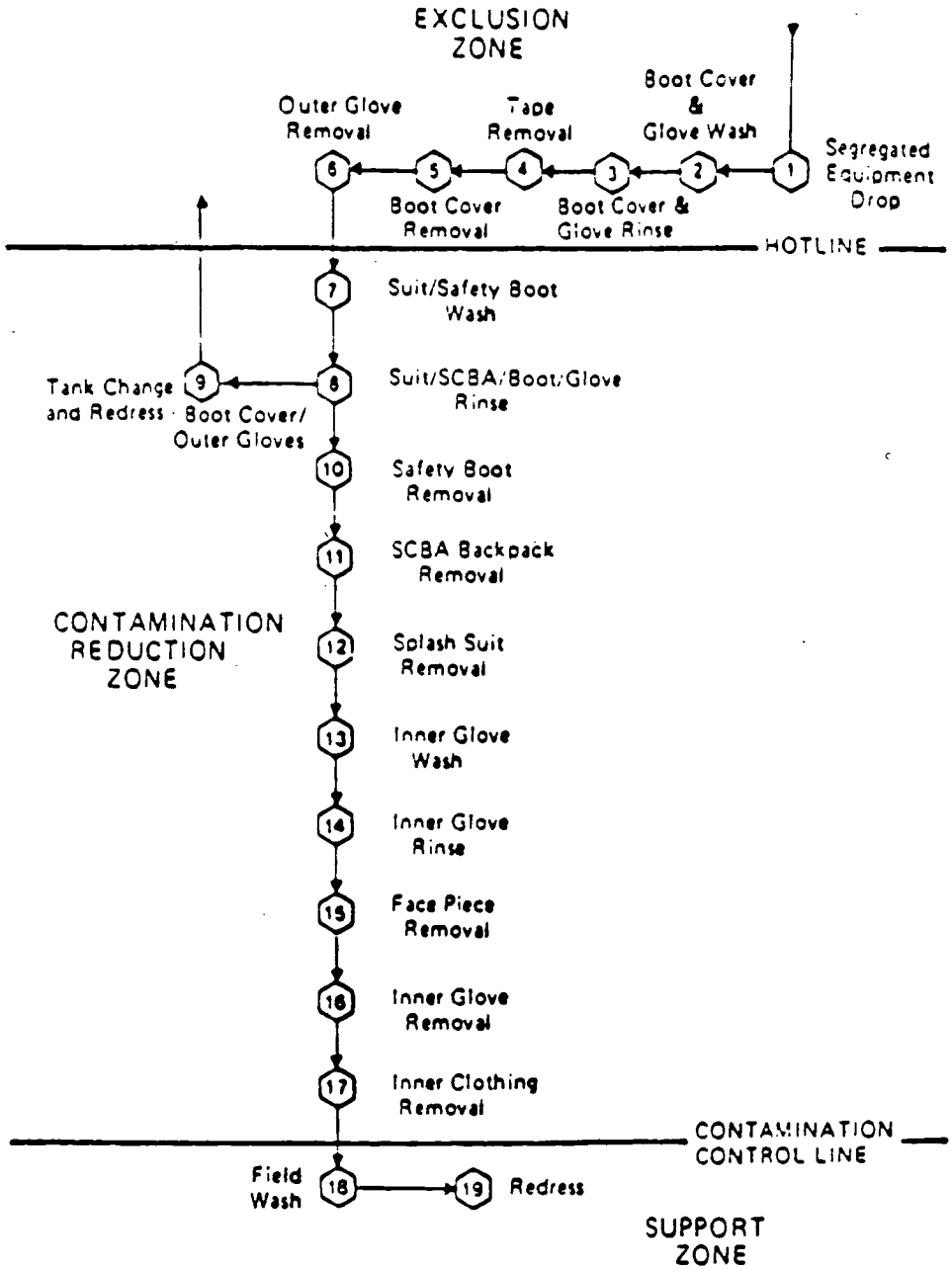
Station 6:
a. Plastic Sheets
b. Basin or Bucket
c. Soap and Towels
d. Bench or Stools

Station 7:
a. Water
b. Soap
c. Tables
d. Wash Basin or Bucket

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.3

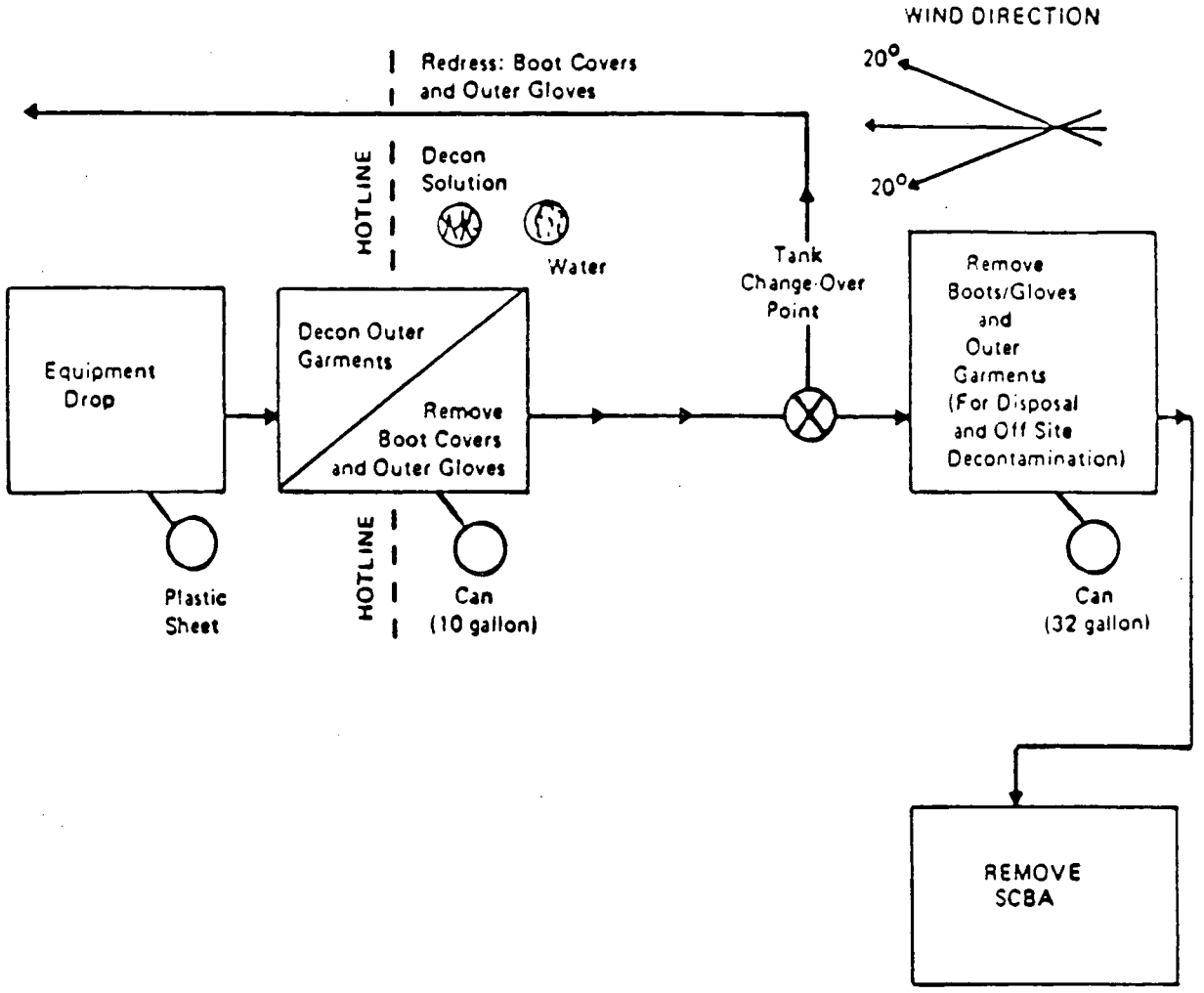
MAXIMUM DECONTAMINATION LAYOUT FOR LEVEL B PROTECTION



SOURCES: NIOSH, OSHA,USCG, and EPA, October 1985
U.S. EPA, November 1984

APPENDIX 5.4

MINIMUM DECONTAMINATION LAYOUT FOR LEVEL B PROTECTION



SOURCES: NIOSH,OSHA,USCG, and
EPA, October 1985
U.S. EPA, November 1984

APPENDIX 5.5

MAXIMUM MEASURES FOR LEVEL B DECONTAMINATION

Station 1:	Segregated Equipment Drop	1.	Deposit equipment used at the site (tools, sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths or in different containers with plastic liners. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Boot Cover and Glove Wash	2.	Scrub outer boot covers and gloves with decon solution or detergent and water.
Station 3:	Boot Cover and Glove Rinse	3.	Rinse off decon solution from station 2 using copious amounts of water.
Station 4:	Tape Removal	4.	Remove tape around boots and gloves and deposit in container with plastic liner.
Station 5:	Boot Cover Removal	5.	Remove boot covers and deposit in container with plastic liner.
Station 6:	Outer Glove Removal	6.	Remove outer gloves and deposit in container with plastic liner.
Station 7:	Suit and Safety Boot Wash	7.	Wash chemical-resistant splash suit, SCBA, gloves, and safety boots. Scrub with long-handled scrub brush and decon solution. Wrap SCBA regulator (if belt-mounted type) with plastic to keep out water. Wash backpack assembly with sponges or cloths.

APPENDIX 5.5, Continued

MAXIMUM MEASURES FOR LEVEL B DECONTAMINATION

Station 8:	Suit, SCBA, Boot, and Glove Rinse	8. Rinse off decon solution using copious amounts of water.
Station 9:	Tank Change	9. If worker leaves exclusion zone to change air tank, this is the last step in the decontamination procedure. The worker's air tank is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.
Station 10:	Safety Boot Removal	10. Remove safety boots and deposit in container with plastic liner.
Station 11:	SCBA Backpack Removal	11. While still wearing face piece, remove backpack and place on table. Disconnect hose from regulator valve.
Station 12:	Splash Suit Removal	12. With the assistance of a helper, remove splash suit. Deposit in container with plastic liner.
Station 13:	Inner Glove Wash	13. Wash inner gloves with decon solution.
Station 14:	Inner Glove Rinse	14. Rinse inner gloves with water.
Station 15:	Face Piece Removal	15. Remove face piece. Deposit in container with plastic liner. Avoid touching face with fingers.
Station 16:	Inner Glove Removal	16. Remove inner gloves and deposit in lined container.

APPENDIX 5.5, Concluded

MAXIMUM MEASURES FOR LEVEL B DECONTAMINATION

Station 17:	Inner Clothing Removal	17. Remove inner clothing. Place in container with liner. Do not wear inner clothing away from the site, because there is a possibility that small amounts of contaminants might have been transferred in removing the outer clothing. Begin a gross alpha radiation survey, when applicable.
Station 18:	Field Wash	18. Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.
Station 19:	Redress	19. Put on clean clothes.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

APPENDIX 5.6

MINIMUM MEASURES FOR LEVEL B DECONTAMINATION

Station 1:	Equipment Drop	1.	Deposit equipment used at the site (tools,sampling devices and containers, monitoring instruments, radios, and clipboards) on plastic drop cloths. Segregation at the drop reduces the probability of cross-contamination. During hot weather operations, a cool-down station may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2.	Scrub outer boots, outer gloves, and chemical-resistant splash suit with decon solution or detergent water. Rinse off with water.
Station 3:	Outer Boot and Glove Removal	3.	Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Tank Change	4.	If worker leaves exclusive zone to change air tank, this is the last step in the decontamination procedure. The worker's air tank is exchanged. New outer gloves and boot covers are put on, and joints are taped. The worker returns to duty.
Station 5:	Boots, Gloves and Outer Garment Removal	5.	Boots, chemical-resistant splash suit, and inner gloves removed and deposited in separate containers lined with plastic.
Station 6:	SCBA Removal	6.	SCBA backpack and face piece are removed. Avoid touching face with fingers. SCBA is deposited on plastic sheets.
Station 7:	Field Wash	7.	Hands and face are thoroughly washed. Shower as soon as possible.

Sources: NIOSH, OSHA, USCG and EPA, October 1985.
U.S. EPA, November 1984.

STANDARD OPERATING PROCEDURE 1.12

AIR PARTICULATE SAMPLING WITH A REAL-TIME AEROSOL MONITOR

1. PURPOSE

To describe the equipment, operation, and procedures for collecting real-time air particulate data.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope of specific operations and the applicability of this procedure to the activities.

2.1 Functions of RAMs

Airborne particulate contaminants can present a significant threat to the health and safety of workers. Real-time aerosol monitoring (RAM) instruments are used to determine the relative concentrations of airborne particulates that may cause a respiratory hazard. These instruments can determine concentrations of airborne particulates in dust, fumes, smoke, and fog. The real-time data obtained from these instruments are used to establish the level of protection for the health and safety of workers and assist in the establishment of possible control measures. The RAM is typically calibrated at the factory and recalibrated by the manufacturer at least annually.

The RAM uses a pulsed, gallium arsenide light-emitting diode source. The radiation scattered by airborne particles is sensed by a silicon-photovoltaic hybrid detector. The instrument continuously senses the combined scattering from the population of particles present within its sensing volume (approximately 1 cm^3) when dimensions are large in comparison to the average separation between the individual airborne particles. The scattering sensing parameters have been designed for preferential response to the range of particle size from 0.1 to 10 microns.

Most RAMs read in units of mg/m^3. In order to quantify the results, apply the appropriate guidelines, and establish action levels, it is necessary to have some knowledge of the sample composition and to determine what percent of the total dust seen is respirable. In some cases, it may be necessary to perform continuous air monitoring in conjunction with the RAM measurements to help identify contaminant characteristics. In terms of dust content, it can be assumed that 100% of the dust produced is silica if drilling through sandstone. In areas where the dust produced is from other sources, quantitative analysis must be performed to determine the exact content of the dust-producing media. The analysis should include the silica content, type of silicates (crystalline, amorphous, coal dust, and others), and a general background analysis of the soil. The results of the soil analyses are then used to establish guidelines for action levels during work activities that are based on the current Threshold Limit Values (TLVs).

2.2 Limitations of RAMs

A. RAMs are designed for qualitative analysis. For that reason, they can be used to provide only an indication of total particulate concentration unless samples of the

medium of interest (like soil) are taken before the work begins and quantitatively analyzed for content.

B. Certain models (GCA Model PDM-3 MINIRAM, for example) satisfy the requirements for intrinsically safe operation in methane and air mixtures. Consult the manufacturer's operating manual for use of these instruments in unknown atmospheres when potentially combustible or flammable compounds may be present.

C. RAMs determine the concentrations of airborne particulates, but do not provide information about the hazardous or toxic nature of airborne particulates.

D. Over time, RAM performance may be affected by the slow buildup of dust in the sensor. Therefore, RAMs must be serviced and cleaned regularly.

E. RAMs respond preferentially to a physical particle size of 0.1 to 10 microns. Some fumes may contain particles smaller than this.

F. The particle size of 0.1 to 10 microns refers to the physical size, as opposed to the aerodynamic size. Different aerodynamic sizes may have different degrees of transportability and respirability.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. The purpose of an office instrument checkout is to verify that an instrument will function properly, the batteries are serviceable, and the instrument can be zeroed and is ready for field use. Ensure the proper operation of the RAM according to instructions included in the operating manual, logbook, and the steps listed below.

1. Check the battery charge level. If in doubt, charge the battery as described in the operating manual.

2. Open the sensor chamber and visually examine the sensor. If cleaning is required, carefully follow the procedures contained in the operating manual.

   CAUTION: Do not touch the lens or the inside of the chamber.

3. Turn the unit on. Verify the operation of the instrument display and other controls according to the operating manual.

4. Perform the zero procedure described in the operating manual. This procedure must be performed in an area known to be free of dust.

   NOTE: The instruments are factory calibrated against a filter gravimetric reference using a standard test dust (Arizona road dust). If recalibration of the instrument is desired, consult the manufacturer's operating manual for the location of the factory that will perform the calibration.

5. If the RAM is not ready for use, initiate steps to have the malfunctions corrected, obtain a working replacement, and repeat the checkout procedures.

3.2.2. <u>Documentation</u>

A. Obtain a logbook from the QA officer.

B. Record all information related to the instrument checkout in the logbook. This information may include the date of the last factory calibration, the date the sensor was last cleaned, the date of replacing the battery pack, and any problems during the instrument checkout. Sign and date the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the initial information on the Real-Time Aerosol Field Monitoring Data form (Appendix 5.2). See Appendix 5.3 for instructions to complete the form.

3.2.3. <u>Field</u>

A. Perform the instrument checkout procedures as described in Section 3.2.1.C.

B. Record the initial information on the Real-time Aerosol Field Monitoring Data form (Appendix 5.2). See Appendix 5.3 for completion of the data form.

3.3. **Operation**

3.3.1. <u>Sampling</u>

For accurate results, follow the instructions contained in the operating manual.

A. Position the instrument near the aerosol source and obtain readings.

B. Position the instrument in the worker's breathing zone and obtain readings according to operating instructions.

C. Record data on the Real-Time Aerosol Field Monitoring Data form (Appendix 5.2) by following the instructions in Appendix 5.3.

3.3.2. Interpretation of Results/Action Levels

A. Apply the results of the quantitative soil sample analyses to the mg/m^3 concentration obtained using the RAM. Consult the site Health and Safety Plan for the exact hazards and the action levels. Action levels are typically 50% of the threshold limit value (TLV).

B. Compare the applicable TLVs to these concentrations. If the estimated concentrations are greater than any of the applicable TLVs, the level of protection must be upgraded to include respiratory protection. Consult the site Health and Safety Plan for current TLVs of the known hazards and the proper respiratory protection. When quantitative contaminant results are not available, the TLV for an upgrade to respiratory protection specified by the site Health and Safety Plan is $10\ mg/m^3$ for total dust containing no asbestos and less than 1% crystalline silica.

Example: Analysis of the soil at a drilling site shows a mica content of 75%. Assuming that 50% of the dust is respirable, a RAM reading of 10 mg/m^3 would result in 3.75 mg/m^3 of mica being inhaled by the workers in that area (0.50 x 10 x 0.75 = 3.75). The TLV time-weighted average (TWA) for mica is a 3.0 mg/m^3, which is less than 3.75. Air purifying respirators with high-efficiency particulate filters would have to be employed.

C. Document all levels of protection in the logbook. Record the time spent in each level, the type of respirator in use, the persons involved, and the concentrations of contaminants.

3.4. Postoperation

3.4.1. Field

A. Turn all switches to the off position.

B. Decontaminate or clean the instrument. If decontamination is required, follow the procedures specified in SOP 1.6, General Equipment Decontamination. If cleaning is required, refer to the manufacturer's operating manual.

C. Charge the instrument batteries as specified in the instrument manual.

D. If necessary, make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Replace expendable items. Return the RAM to the equipment manager and identify any operational problems from previous use.

4. SOURCE

GCA/Environmental Instruments. n.d. "Instruction Manual for Model PDM-3 Miniature Real-Time Aerosol Monitor (Miniram)." GCA/Environmental Instruments publication. Bedford, Massachusetts: MIE Incorporated.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Real-Time Aerosol Field Monitoring Data Form

5.3. Data Form Completion

APPENDIX 5.1

REAL-TIME AEROSOL MONITOR EQUIPMENT AND SUPPLIES CHECKLIST

_____ RAM

_____ Operating manual

_____ Battery charger

_____ Spare battery pack

_____ Jeweler's screwdriver

_____ Current ACGIH TLV indices

APPENDIX 5.2

REAL-TIME AEROSOL FIELD MONITORING DATA FORM

REAL – TIME AEROSOL FIELD MONITORING DATA

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD REP _____

MANUFACTURER _____

MODEL NO _____ SERIAL NO _____

DATE CALIBRATED _____ **ACCEPTANCE CODE** _____

FIELD MEASUREMENTS

LOCATION ID OR DESCRIPTION	**TIME (HH:MM)**	SAMPLE TYPE	ACTIVITY TYPE	CONCENTRATION (mg/m^3)	COMMENTS

ACCEPTANCE CODES: A–ACCEPTABLE M–MARGINALLY ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

SAMPLE TYPES :
A – AREA G – GRAB P – PERSONAL T – TIME WEIGHTED AVERAGE O – OTHER (SPECIFY)

ACTIVITY TYPES:
AM – AMBIENT (BACKGROUND) TR – TRENCHING OPERATION CS – CONFINED SPACE
DR – DRILLING OPERATION SS – SURFACE SOIL SAMPLING OT – OTHER (SPECIFY)

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
AER–043 (3/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

REAL-TIME AEROSOL FIELD MONITORING DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date that information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Manufacturer. The name of the company that manufactures the real-time aerosol monitor (RAM) instrument being used.

6. Model No. The model number of the RAM.

7. Serial No. The serial number of the RAM.

8. Date Calibrated. The date when the RAM was calibrated. This data field follows the same format as the data field for log date.

9. Acceptance Code. One-character code assigned by the site manager.

10. Location ID or Description. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

11. Time (HH:MM). The time when a RAM reading was taken using the 24-hr clock in the format of hours:minutes (for example, 08:37 for 8:37 AM and 19:12 for 7:12 PM).

12. Sample Type. The type of sample taken by the RAM.

    T - Time-weighted average (TWA)
    G - Grab sample
    A - Area sample
    P - Personal sample
    O - Other (specify)

13. Activity Type. A two-character code describing the mode of investigation that is being monitored. Acceptable codes are included at the bottom of the field form.

14. Concentration (mg/m^3). The units in which the RAM reads. Unless otherwise specified in the FSP or WP, the units mg/m^3 will be used.

15. Comments. Any additional information.

STANDARD OPERATING PROCEDURE 1.15

GUIDE TO WASTE MANAGEMENT

1. PURPOSE

To provide a general guide for the management of investigation-derived wastes at the Mound Plant.

2. DISCUSSION

This standard operating procedure (SOP) describes the procedures used by the Environmental Restoration (ER) Program technical assistance contractor for the sampling, storing, and disposal of investigation-derived wastes (IDW). Part of this procedure includes the discussion of waste segregation and drum reuse. Other procedures or requirements used by installation subcontractors must conform to this SOP.

Wastes generated during a site investigation are classified as either environmental or hazardous materials. In general, wastes generated during environmental site investigations are derived from soil borings, well construction and installation, aquifer testing, and water quality sampling of wells and decontamination of sampling equipment (rinsate). Soil and water are stored in drums, with the drums containing soil stored at the original sampling site when possible and the drums containing water stored at a central staging location. The wastes are stored pending the results from the analytical tests to determine whether the wastes are hazardous based on CERCLA and RCRA criteria.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, SOPs 1.1 through 1.10 must be reviewed. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies, decontamination procedures, and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.5	Guide to the Handling, Packaging and Shipping of Samples
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the Workplan or Sampling and Analysis Plan, and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Determine that sufficient drums and labeling materials are available for storage of waste.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Obtain a sufficient number of the appropriate ER Program data collection forms. Consult Mound Plant ER Program SOP Table of Contents (DOE 1991).

C. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms and drum labels.

3.3. Operation

The following step-by-step procedure will ensure that all agreed to practices are followed in the management of investigation-derived wastes. A decision tree illustrating these procedures is shown on Figure 1.

3.3.1. Drum Labeling

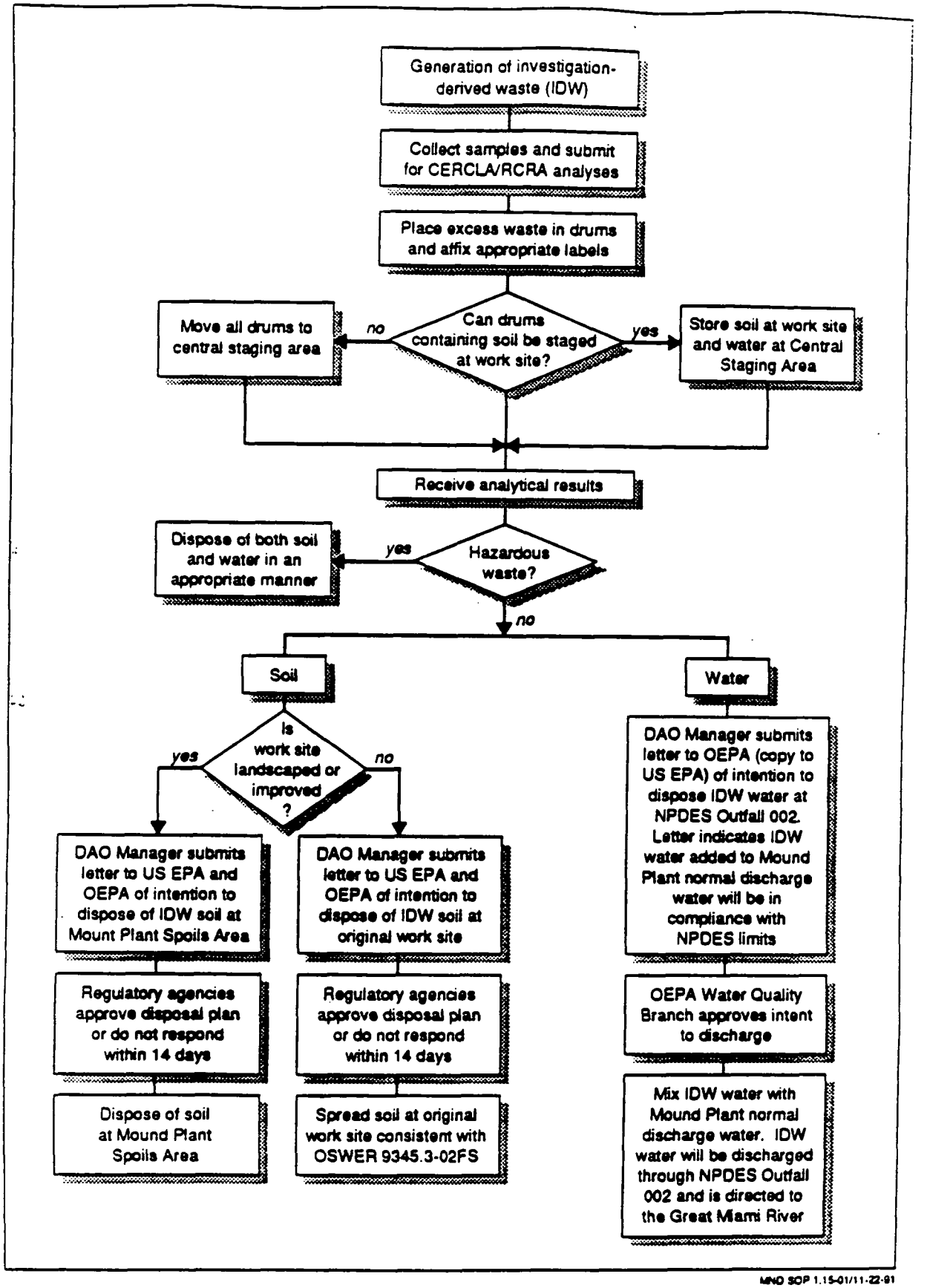
Drums will be marked with waterproof labels with the following information:

- date filled;
- source location ID (release site/well [for decon water]);
- medium (soil, water, or personal protective equipment);
- statement to the effect: "Investigation-derived waste from CERCLA RI/FS; for more information contact subcontractor manager (name, phone number), Kathy Koehler (x 4486), or Monte Williams (x 4543)";
- marking with head space analysis value, if applicable; and
- sample numbers

3.3.2. Soil

A. The soil samples that have been collected at the work site will be transmitted to the laboratory for CERCLA and RCRA analyses.

B. Remaining soil that is not sampled will be placed in open-top metal drums, which will be labeled and stored at the original sampling site whenever possible.



MND SOP 1.15-01/11-22-91

C. Drum groups within the staging area will be placed on wooden pallets and will be covered with tarps to prevent weathering of the drums and to protect label integrity.

D. A sign posted within each staging area will identify the drums as "Investigation-Derived Wastes" and will include the same information described in Section 3.3.1.

E. After receiving analytical results, the soil will be determined to be either hazardous or non-hazardous.

F. If the soil is non-hazardous, the remedial project manager at DAO will submit a letter to U.S. EPA and OEPA that will address the points below. An example letter is included here as Attachment A.

- general summary of results;

- criteria for release; and

- intent to return the IDW soil to the designated work site if U.S. EPA/OEPA approves the disposal or does not respond to the contrary within 14 days. A sketch map of the area to be used will accompany the notice letter. The ER-defined work site is considered to be synonymous with the area of contamination discussed in OSWER 9345.3-02FS (EPA 1991).

Upon U.S. EPA/OEPA approval or non-response, soils determined to be non-hazardous will be spread over unimproved areas of the original work site (consistent with OSWER 9345.3-02FS). At the work site, soils will be spread over the minimum area to allow leveling to the approximate original grade of the site. If the soils cannot be returned to the work site, they will be disposed at the Mound Plant spoils area. At the spoils area, soils will be disposed in a manner that is consistent with operating protocols of that location.

In cases involving borehole drilling, the soil cuttings will not be returned to the original borehole. Instead, the open borehole will have been grouted to the ground surface and the area surrounding the borehole will be considered the work site. In cases when the work site has undergone construction, landscaping, or general improvement, the soil will be disposed of at the Mound Plant spoils area.

G. If the soil is determined to be hazardous, it will be disposed of in an appropriate manner.

H. Solid waste generated by the technical assistance contractor and subcontractor(s) (e.g., wipes, protective clothing, visqueen, garbage) will be segregated and disposed of separately in a proper disposal area.

I. Bulk (large pieces) of asphalt or concrete waste generated by breaking through pavement will be segregated and disposed of separately in a proper disposal area.

3.3.3. Water

A. The water samples that have been collected at the work site will be transmitted to the laboratory for CERCLA and RCRA analyses.

B. The remaining water that is not sampled will be placed in closed-top polyethylene drums, which will be labeled and stored at a central staging area, currently the Waste Oil Drumfield, a potential release site on the SM/PP Hill.

C. Drum groups will be placed on wooden pallets and covered with tarps to protect label integrity.

D. A sign posted within each staging area will identify the drums as "Investigation Derived Wastes" and will include the same information described in Section 3.3.1.

E. After receiving analytical results, the water will be determined to be either hazardous or non-hazardous.

F. If the water is non-hazardous, the DAO remedial project manager will submit a letter to the OEPA water quality branch indicating that the IDW water will be added to normal Mound Plant discharge and will be in compliance with NPDES limits. A copy of this letter will be submitted to U.S. EPA by DAO.

   Upon approval from OEPA, the water will then be discharged through Mound Plant NPDES Outfall 002 and directed offsite to the Great Miami River. DAO will simultaneously notify U.S. EPA of the intent to discharge.

G. If the water is determined to be hazardous, it will be disposed of in an appropriate manner.

H. Liquid waste generated by the technical assistance contractor and subcontractor(s) (e.g., motor oil, additives, detergent solutions) will be segregated and disposed of separately at a proper disposal area.

3.3.4. Central Staging Area

A. The Central Staging Area is currently the Waste Oil Drumfield. It will be used to store

   - purge water from wells;

   - soil that cannot be stored at the work site because it hinders Mound Plant operations; and

   - soil from areas off the site (e.g., the Miami-Erie Canal).

B. The Waste Oil Drumfield will be used immediately with the knowledge that it is a release site and remedial activities are in progress.

C. After results of sampling and analysis are available, assuming that no remediation is required, the Waste Oil Drumfield will become a semi-permanent staging area for CERCLA wastes. It will be fenced and locked, with ER Program (EG&G and its contractors) to retain control of the area. It is presumed that at the conclusion of the ER Program, the area may need to be sampled again to verify that it was not contaminated by spills.

3.3.5. Waste Segregation

A. Waste Segregation will be practiced at a central staging area. Drums presumed to contain radioactive soil (e.g., from Miami-Erie Canal) will be labeled as such and will be kept in a separate zone from those presumed to contain hazardous waste. This is to prevent the creation of mixed waste if both types were to spill.

3.3.6. Drum Database

A database will be created and maintained for the duration of time that drums contain IDW soil/ water. The database will contain information described in Section 3.3.1 and include a timeline documenting waste management procedures.

3.3.7. Drum Reuse

A. Empty drums used to store non-hazardous solid wastes that are disposed of at the work site or spoils area will be rinsed of visible solid residue on location. Drums used to store non-hazardous liquid wastes that are disposed of into NPDES Outfall 002 are not expected to contain solid residue and will not be rinsed. When these procedures are completed, empty drums may be reused for subsequent wastes generated by the ER Program (it is assumed that drums will be reused only within the ER Program).

B. Drums that previously held low-specific activity (LSA) waste and have been emptied into LSA containers should be marked and retained only for radioactive soil that is unlikely to be hazardous waste.

C. It is assumed that drums containing waste that is determined to be hazardous will be shipped off the site with the waste.

3.4. Postoperation

3.4.1. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

3.4.2. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/ she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

4. REFERENCES

DOE. 1991. "Standard Operating Procedures." Mound Plant, Environmental Restoration Program, U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico, January 1991.

EPA. 1991. "Guide to Management of Investigation-Derived Wastes." U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Publication: 9345.3-02FS, May 1991.

Attachment 1

EXAMPLE OF NOTIFICATION LETTER TO DISPOSE OF INVESTIGATION-DERIVED WASTE

This is to notify you of DOE's intent to return nonhazardous investigation-derived waste (IDW) to the original work site [OR to place IDW in the Mound Plant spoils disposal area].

Particulars are as follows:

1) Source of the materials: Cuttings from potential release site _XYZ_, Operable Unit _N_, generated _DATE_. The materials include [DESCRIPTION].

2) Results of chemical analysis/hazardous waste testing are attached.

3) The materials will be spread on the land surface at the work site at the location shown on the attached sketch map [OR the materials cannot be returned to the work site because...].

4) Unless we hear to the contrary by _DATE_, DOE will proceed with the disposal. [NAME] is the Project Engineer and is available at [PHONE NUMBER] to answer any further questions.

[DOE DAO SIGNATURE BLOCK]

STANDARD OPERATING PROCEDURE 2.1

PRESAMPLE PURGING OF WELLS

1. PURPOSE

To identify well-purging procedures for evacuation of stagnant water from the well bore and its replacement by groundwater in sufficient quantities so that a water sample representative of the formation of completion can be collected.

2. DISCUSSION

The choice of procedure and equipment for well evacuation depends on the Field Sampling Plan (FSP) or Work Plan (WP), the yield of the well, water depth, well size, and the type of water analysis. This procedure describes various methods for well evacuation. Collection and measurement of samples and the documentation of data should be performed as described in the associated procedures.

Peristaltic Pump

Using a peristaltic pump for well evacuation is particularly advantageous because the same system may be used for sample collection. In addition, the flow rate is easily controlled with a peristaltic pump. The pump can be used in wells of any diameter and nonplumb wells, and the pump is highly portable and readily available. However, peristaltic pumps can only be used in wells with a potentiometric level less than 25 ft below the land surface. Additionally, low pumping rates make it difficult to evacuate the wellbore in a reasonable amount of time. An electric power source is required, and there is a high likelihood of stripping the volatiles.

Bladder Pump

The bladder pump (Middelburg type or diaphragm) is a particularly good choice when the well depth is beyond the capability of the peristaltic pump. In addition, the relatively high pumping rate allows rapid well evacuation. Bladder pumps are portable, though the accessory equipment may be cumbersome. With deep purging, large volumes of gas and longer cycles are required. Operating time and expense are increased as a result.

Bailer

For shallow, small-diameter wells with low yields, evacuation of the well by bailer is recommended. Bailers are mechanically simple, lightweight and highly portable, constructed in many sizes, and require no external power source. Bailers are easily operated and cleaned and inexpensive. The primary disadvantage of bailers is their limited-volume purging capability, especially in deep wells where purging is labor and time consuming. Another disadvantage is that sampling personnel are directly exposed to contaminants.

Electric Submersible Pump

The submersible pump is commonly used for purging deep, large-diameter wells requiring high pumping rates. The pump is portable and self-contained except when auxiliary power sources are employed. The primary disadvantage is that the pump can be difficult to decontaminate and transport. Other disadvantages are damage caused by dry pumping, damage to the gears (when the water contains high levels of suspended soils), and the high cost of these large-capacity pumps.

Reciprocating Piston Submersible Pumps

The reciprocating piston submersible pump is a portable system for purging wells with water depths up to 500 ft. These pumps develop high pumping rates and can be operated in 2-inch-diameter wells. The system is operated by compressed gas (air or nitrogen) and driven by an air motor. The pump is self-priming, and the gas that drives the pump does not contact the purged water. The pump is constructed from stainless steel and can be decontaminated easily.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
2.3	Sampling Monitoring Wells with a Bladder Pump
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer
2.5	Sampling Monitoring Wells with a Submersible Pump
2.6	Sampling Monitoring Wells with a Peristaltic Pump
3.1	Water Level Measurement
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector

6.3 Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Have the site manager order the standard solutions for specific conductance and pH/alkalinity calibrations to be performed either before departing for the site or upon arrival at the site.

F. Consult with the site manager about purging techniques and the disposal of purged water and other sampling expendables.

G. Make arrangements to buy or lease an air compressor or bottled nitrogen.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells to be sampled and the appropriate decontamination area. Locate the staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access. Plan to purge the wells, moving from the least contaminated to most contaminated.

B. Decontaminate the purging pump or bailer before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

A. Record all calculations and field measurements according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

B. Calculate the amount of water in the well (casing or bore volume) with the formula shown below.

$$(pi) \times \frac{(d^2)}{4} \times (h_1 - h_2) \times 7.48 = \text{gallons per bore volume}$$

where

pi = 3.1416
d = inner diameter of well bore (ft)
h_1 = depth of well from top of well casing (ft)
h_2 = depth to water from top of casing (determined in field) (ft)
bore volume = volume of water equivalent to the standing water in a well

3.3.1. Peristaltic (Suction-Lift) Pump

The peristaltic pump is a self-priming, low-volume pump consisting of a rotor and ball-bearing rollers. Tubing inserted around the pump rotor is squeezed by the rollers as the rotor revolves. One end of the precleaned tubing is placed into the well while the other end is connected to a flow-through bath. As the rotor revolves, water is drawn (up to one gallon per minute) from the well.

For purging with a peristaltic pump, proceed as described below.

1. Using clean equipment, determine the total depth of the well and water level with an electric sounder or steel tape (see SOP 3.1, Water Level Measurement). Calculate the fluid volume in the casing, using the casing volume or the bore volume (the FSP or WP may require considering the latter).

2. Determine the depth from the casing top to the midpoint of the screen or well section open to aquifer. Consult the well completion and water level measurement records or sound for the bottom.

3. If depth to midpoint of screen exceeds 25 ft, choose an alternate system.

4. Lower intake into the well a short distance below the water level and begin water removal. Collect or dispose of the purged water in containers of the type specified in the FSP or WP. Lower suction intake to maintain submergence and allow for successive purging of the water column.

5. Monitor the air above the wellhead (as specified in SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector) to determine the potential for explosion, fire, and any toxic effect on workers.

6. Record the amount of water purged and discharge rates. A calibrated bucket and stopwatch are most commonly used to obtain this measurement.

7. Purge a minimum of three casing volumes and continue purging until the discharge parameters (pH, temperature, and specific conductance) stabilize. Stabilization of field parameters is defined as consecutive readings (taken with at least 0.5 casing volumes between readings) within ±0.1 units for pH, ±1 degree for temperature, and ±10 percent for conductivity. It should be realized that groundwater from some wells may not readily stabilize, either due to effects of improper well construction or the presence of contaminants. In these instances, a maximum of 10 casing volumes will be removed before sampling, and the lack of stabilization of parameters should be noted in the comments field of the appropriate field forms.

8. After pumping, monitor the water level recovery. The recovery rate may be useful in determining the sample rate.

9. Decontaminate the tubing and fittings according to SOP 1.6, General Equipment Decontamination.

3.3.2. Bladder (Gas-Operated, Squeeze-Type) Pump

Bladder pumps consist of a membrane enclosed in stainless steel housing. Water enters the membrane through a lower check valve; compressed gas is injected into the cavity between the housing and bladder. Water is transported through an upper check valve and into a discharge line. The process is repeated to cycle the water to the surface and into the flow-through bath.

For purging with a bladder pump, proceed as described below.

1. Using decontaminated equipment, determine the total depth of the well and the water level with an electronic level indicator (see SOP 3.1, Water Level Measurement). Then calculate the fluid volume in the well casing (either casing or bore volume).

2. Determine the depth from the casing top to the midpoint of the screen or well section open to aquifer (consult well completion and water level measurement records). If two or more screen sections are present, determine at which section to set intake and note in logbook.

3. Lower pump assembly into the well until the pump is near the middle of the screened interval.

4. Attach compressed gas and discharge lines. Adjust cycle.

5. Begin water removal; collect or dispose of the purged water in containers of the type specified in the FSP or WP.

6. Monitor the air above the wellhead according to the FSP or WP to determine the potential for fire, explosion, and any toxic effect on workers.

7. Measure the rate of discharge frequently (every two gallons). A calibrated bucket and stopwatch are commonly used to obtain this measurement.

8. Purge a minimum of three casing volumes and continue purging until the discharge parameters (pH, temperature, and specific conductance) stabilize. Stabilization of field parameters is defined as consecutive readings (taken with at least 0.5 casing volumes between readings) within ±0.1 units for pH, ±1 degree for temperature, and ±10 percent for conductivity. It should be realized that groundwater from some wells may not readily stabilize, either due to effects of improper well construction or the presence of contaminants. In these instances, a maximum of 10 casing volumes will be removed before sampling, and the lack of stabilization of parameters should be noted in the comments field of the appropriate field forms.

9. After pumping, monitor the water level recovery. The recovery rate may be useful in determining the sample rate.

10. Decontaminate the pump assembly (see SOP 1.6, General Equipment Decontamination).

3.3.3. Bailer

Water is removed from the bore by a vessel of known volume. The vessel fills with water, and the unit is retrieved with a line or rope.

For purging with a bailer, proceed as described below.

1. Using decontaminated equipment, determine the total depth of the well and the water level with an electric sounder or steel tape (see SOP 3.1, Water Level Measurement). Then calculate the fluid volume in the well casing (either casing or bore volume). If considering the amount of water in the well casing and the filter pack is required, consult the FSP or WP for the appropriate calculations.

2. Lower the bailer into the well and begin water removal. Collect or dispose of purged water in containers of the type specified in the FSP or WP.

3. The air above the wellhead must be monitored (as specified by SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector) to determine the potential for explosion, fire, and any toxic effect on workers.

4. Record the amount of water purged and discharge rates frequently (every two gallons). A calibrated bucket and stopwatch are commonly used to obtain this measurement.

5. Purge a minimum of three casing volumes and continue purging until the discharge parameters (pH, temperature, and specific conductance) stabilize. Stabilization of field parameters is defined as consecutive

readings (taken with at least 0.5 casing volumes between readings) within ±0.1 units for pH, ±1 degree for temperature, and ±10 percent for conductivity. It should be realized that groundwater from some wells may not readily stabilize, either due to effects of improper well construction or the presence of contaminants. In these instances, a maximum of 10 casing volumes will be removed before sampling, and the lack of stabilization of parameters should be noted in the comments field of the appropriate field forms.

6. Once the well has been bailed, monitor the water level recovery. The recovery rate may be useful in determining the sampling rate.

7. Decontaminate the bailer (see SOP 1.6, General Equipment Decontamination).

3.3.4. Electric and Reciprocating Piston Submersible Pumps

The pump assembly is suspended from the discharge tubing and submerged in the well. Water is transported through the discharge tube to the surface by centrifugal or piston action. A portable generator (or battery) is used to provide a power source for the electric pump and a winch in some cases. A portable air compressor is used to drive the piston-type pump.

For purging with a submersible pump, proceed as described below.

1. Purge the well as prescribed in steps 1-3 and 5-9 in method 3.3.1.

2. Decontaminate the pump assembly (see SOP 1.6, General Equipment Decontamination).

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions specified in the FSP or WP.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or incomplete purging) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document

control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to equipment manager and report incidents of malfunction or damage.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

Korte, N., and P. Kearl. 1984. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells." U.S. Department of Energy, Grand Junction, Colorado.

Morrison, R.D. 1983. "Ground Water Monitoring Technology, Procedures, Equipment and Applications." TIMCO Manufacturing, Inc., 85-90, Evanston, Illinois.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Purging pump or bailer

_____ Water level sounding device

_____ Calculator

_____ Conductivity meter

_____ pH meter

_____ Digital titration kit

_____ Calibration solutions

_____ Air compressor or bottled nitrogen (as needed)

STANDARD OPERATING PROCEDURE 2.2

FIELD MEASUREMENTS ON GROUND AND SURFACE WATER SAMPLES

1. PURPOSE

To obtain reliable and accurate measurements of the field chemistry (pH, temperature, electrical conductivity, alkalinity, dissolved oxygen, redox potential) of water quality samples. It should be noted that dissolved oxygen is not routinely measured as part of groundwater monitoring. Refer to the Field Sampling Plan (FSP) or Work Plan (WP) for details on the measurements to be performed.

2. DISCUSSION

For several reasons, taking measurements of water chemistry in the field is preferable to taking measurements in the laboratory. If it is suspected that a particular sample is not representative or valid, resampling and reanalyzing can be immediately performed at the site. In addition, the values of pH, specific conductance, and alkalinity in water chemistry measurements in the field may differ from those in the laboratory. Disadvantages encountered in obtaining field measurements usually relate to the reliability of the particular method and equipment used for the test.

The FSP or WP contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.3	Sampling Monitoring Wells with a Bladder Pump
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer

2.5	Sampling Monitoring Wells with a Submersible Pump
2.6	Sampling Monitoring Wells with a Peristaltic Pump
2.8	Sampling for Volatile Organics
2.9	Surface Water Sampling
3.1	Water Level Measurement
4.3	Monitoring Well Installation

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment. Ensure that there are sufficient quantities of reagents, solutions, and filters.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Consult the site manager about purging techniques, the disposal of purged water and other sampling expendables, and the purchase of standard solutions for electrical conductivity and pH/alkalinity calibrations.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells to be sampled and the appropriate decontamination area. Locate the staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access. Plan to purge and sample the wells,

moving from the least contaminated well to the well with the highest level of contamination.

B. Assemble the appropriate sampling equipment (tubing, flow-through bath, water quality meters, and other equipment). Check the condition of all supplies and the operation of the equipment. It should be noted that a flow-through bath cannot be used if a bailer is being used for the water sampling.

C. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP). Rinse pH and conductivity probes with distilled water between measurements. Collect all decontamination solutions and rinsate liquids in a container or drum and dispose of them at the conclusion of the sampling event. If data exist that show that the decontamination and rinsate liquids will not contribute to contamination at the site, they may be disposed of at the site. Rinsate liquids can be disposed of at the wellsite as long as the disposal area is at least 10 ft from the nearest well.

D. Perform field calibrations for all instrumentation.

3.3. Operation

Procedures for measuring the parameters are discussed below. When practical, take final field measurements after at least three bore volumes have been pumped from the well and as close to the time of sampling as possible. Record measurements, instrument readings, calibration runs, and alkalinity determinations on the appropriate forms included in Appendixes 5.2 through 5.5. Complete the forms as described in Appendix 5.6.

3.3.1. Determining pH

A. Connect the probe to the meter. If a flow-through bath is being used, immerse the meter in the bath after pumping has begun. (A flow-through bath is an enclosed container made of inert material that houses the pH probe and calibration buffer solutions.) The bath allows the buffer solutions to reach the same temperature as the water being withdrawn, and this results in the proper calibration/standardization of the pH meter. The flow-through bath will reduce or eliminate drift. If a flow-through bath is not being used, pour an aliquot of the water into a beaker and immerse the probe in the beaker.

B. Bring the standard solutions to the temperature of the water in the flow-through bath. If the meter has a temperature adjustment, set it to the temperature of the water.

C. Rinse the probe in distilled water and pat completely dry with a clean tissue before putting it in a calibrating solution. Avoid rubbing the probe, which may cause a static charge that will disrupt measurements.

D. Standardize the meter immediately before taking the measurement. The calibrating solutions must bracket the sample--either pH 7.0 and pH 4.0 or

pH 7.0 and pH 10.0. Use the procedure described below to standardize the meter.

1. Put the probe in the pH 7.0 (or in the pH 4.0 solution if the pH is less than 4.0) and adjust the standardization knob to achieve a reading of 7.0 (or 4.0 for pH less than 4.0).

2. Put the probe in the other solution and adjust the standardization knob to achieve a reading of 4.0 or 10.0, as appropriate.

3. Repeat those two steps until adjustment is no longer required.

E. Clean the probe with distilled water and clean tissues.

F. If a flow-through bath is being used, put the probe in the bath. Record the measurement within 5 min or after drift has ceased, whichever is sooner. If a bath is not being used, place the probe into a beaker containing an aliquot of water. Record the measurement as described.

G. Immediately rinse and dry the probe and put it in each calibrating solution for about 30 sec. Record the readings.

NOTE: During storage and between measurements, keep the probe immersed in the pH 4.0 solution.

H. If a flow-through bath is being used, keep hoses leading to the bath out of direct sunlight because the water can heat up quickly at low discharge rates.

3.3.2. Measuring Temperature

A. Use a Celsius thermometer to measure the temperature in a small Teflon or plastic bucket. Record measurements in the logbook periodically during pumping.

B. Place the bucket close to the wellhead. Keep the bucket and discharge hose away from direct sunlight.

3.3.3. Measuring Electrical Conductivity

A. Use three KCl solutions of known concentrations (approximately 500, 1000, and 1500 μmhos, depending on vendor availability); these concentrations must bracket the expected electrical conductivity (Ec) of water samples collected in the field. Record the electrical conductivity of the known solutions after the meter probes have been submersed and equilibrated in them. The temperature of the known solutions must be 25°C and recorded from a laboratory-grade thermometer.

B. Cool one KCl known solution to 0°C. Then record electrical conductivity measurements as the temperature of the KCl solution is warmed to 25°C. During this calibration procedure, also record the temperature scale of the Ec meter to confirm the accuracy of the Ec meter thermometer to the known accuracy of the laboratory-grade thermometer.

C. Calibrate the conductivity meter with at least three standard KCl solutions, the extremes of which bracket the anticipated conductivity of the samples. Perform this calibration at least before and after sampling. Keep a record of each calibration and record the temperature of each calibrating solution.

D. Clean the probe and cable with distilled water and clean tissues.

E. Measure conductivity in a Teflon or plastic bottle. Record conductivity periodically (after every two gallons) throughout the time of pumping. Record the position of each setting on the meter.

NOTE: Rinse the probe in distilled water and dry it completely before putting it in a calibration solution.

F. Keep the probe at least two inches away from the cell walls or bucket because most conductivity probes produce an electrical field that may be disturbed if the probe is near a solid object.

3.3.4. Alkalinity Testing

Use a digital titration kit (Hach Kit) to test for alkalinity. Field techniques can be tested by performing alkalinity tests on known solutions prepared by the quality control laboratory. When using the standard solutions, record only the value of alkalinity at a pH of 4.5 on the Standard Alkalinity Record form (Appendix 5.5). The alkalinity of three standard solutions will be determined in triplicate. Perform these tests at the start of field sampling. Report the results to the site manager for confirmation with the known values reported by the laboratory. At the discretion of the site manager, additional standard alkalinity tests may be performed periodically during or after the field sampling period.

Determine the alkalinity of each water sample at the time that the sample is collected; record the results in the appropriate sections of the Groundwater Quality Sampling Record (Appendix 5.3) or Surface Water Quality Sampling Record (Appendix 5.2). Enter alkalinity values for 13 different pH values into the table on the forms and plot the results on the graph. Perform a minimum of two tests on each sample to verify the reproducibility of the values obtained. If possible, have different field personnel run these two tests. If the calculated error is greater than 10%, perform a third test for a redetermination of the error. Three trials are usually sufficient to determine a reasonable field value. At the conclusion of the titration tests, record the pH meter readings in the pH 4.0 and 7.0 buffer solutions. The procedure used to determine alkalinity values is described below.

A. Bring the temperature of the pH 4.0 and 7.0 standard buffer solutions to the temperature of the sample in the flow-through bath. If a flow-through bath is not being used, bring the temperature of the standard solutions to the temperature of the water in the beaker. Standardize the meter with the electrode in each of these buffers according to the accepted method. Leave the electrode in the pH 4.0 buffer solution.

B. Rinse the titration flask and the volumetric flask with distilled water, followed by raw sample. Remove droplets of water by vigorous shaking.

C. Measure 100 ml of fresh, unfiltered sample in the volumetric flask and pour it into the titration flask with as little agitation as possible.

D. Rinse the pH electrode, pat it dry, and put it into the titration flask.

E. Record the titrant lot number and date on the water quality data form. Eject a few drops of titrant from the tip of the titrator and wipe the tips with a clean tissue. Reset the counter to 0000.

F. Titrate the solution with acid, gently stirring the solution to ensure mixing. Whenever feasible, use magnetic stirrers. Record pairs of pH and alkalinity readings for the pH values on the data form(s).

G. Rinse all glassware with distilled water.

3.3.5. Measuring Dissolved Oxygen

A. Connect the YSI 5739 probe to the YSI Model 50B Dissolved Oxygen meter. Place probe in calibration bottle containing a moist sponge. Allow the temperature to equilibrate (3-5 minutes).

B. Set function switch to "°C". From the solubility of oxygen chart (Table I on back of meter) find the mg/L value for the temperature indicated on the display.

C. To determine the calibration value, multiply the value in mg/L found in step B. by .97 (the value in .97 is from Table II on back of meter using an elevation of 841' for Mound Plant).

D. Set function switch to "mg/L CAL". Using the keys beneath the digit positions in the display, set the calibration value determined in step C. Set function switch to "mg/L". The display will show "CAL", then the calibration value entered will appear. Observe the reading for stability for two or three minutes.

E. Place probe in sample. Set function switch to "mg/L". Allow 3-5 minutes for the probe to come to temperature equilibrium with the sample. Begin stirring and observe the reading when the display has stabilized.

F. Record observed reading in the comment section of the field form (Appendix 5.2 or 5.3).

G. When storing probe, keep in humid environment to prevent drying out.

3.3.6. Measuring Oxidation-Reduction Potential

A Hach One Portable pH Meter may be used to measure oxidation-reduction potential with the proper electrode (Hach OPR Electrode). First the meter must be zeroed for millivolt measurements.

A. With meter turned off, insert a paper clip into the BNC connector to electrically short the circuit.

B. Press and hold the button labeled "mV", simultaneously press and release button labeled"!" then release "mV" button. The mv indicator will light, and after 10 seconds, the meter will read 0.0 mV+.2 mV. Remove paper clip and attach OPR electrode.

C. Verify the electrode response by measuring the oxidation-reduction potential of a prepared solution. No calibration can be done with this meter, if electrode is not reading correct value, replace it with a new one.

Note: Calibration solution preparation is given in manual for Hach OPR Electrode.

D. Record observed reading in the comment section of the field form (Appendix 5.2 or 5.3).

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Examine electrical conductivity and temperature calibrations (red line location). Adjust data as indicated.

E. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration) in the logbook.

B. Record the sampling and operating data in the logbook.

C. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

D. Make any necessary changes on data forms after examining electrical conductivity and temperature calibrations.

E. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document

control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

EPA. 1979. "Methods for Chemical Analysis of Water and Wastes." U.S. Environmental Protection Agency document EPA/600/4-79-020. Washington, D.C.: U.S. Government Printing Office.

Korte, N., and P. Kearl. 1984. "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells." U.S. Department of Energy, Grand Junction, Colorado.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Surface Water Quality Sampling Record

5.3. Groundwater Quality Sampling Record

5.4. Standard Electrical Conductivity Data Form

5.5. Standard Alkalinity Test Record

5.6. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

Complete all blanks before going to the field.

_____ Reagents: Alkalinity kit

- _____ Check reagent volumes
- _____ Check glass for breakage

_____ pH meter(s) (circle one)

- _____ Electrode full of fluid
- _____ Electrode glass intact
- _____ Immerse electrode in tap water
- _____ Calibrate electrode, rinse, fill, and replace cap
- _____ Temperature probe in tap water
- _____ Temperature probe in hot water

_____ Ec Meter

- _____ Battery: Ok___ Dead___
- _____ Tap water: Ok___ Faulty___
- _____ Against calibration solution
- _____ Solution temp
- _____ Conductivity of solution

_____ Hand-held thermometer

- _____ Temperature in ice water
- _____ Temperature agrees with lab thermometer

_____ KCl solutions

_____ Filters and tubing

_____ Flow-through bath

_____ Teflon or plastic bucket

_____ Teflon or plastic bottle

APPENDIX 5.1, Continued

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Titration flask

_____ Volumetric flask

_____ YSI Model 50B dissolved oxygen meter

- _____ YSI 5739 dissolved oxygen probe
- _____ YSI 5740 detachable cable
- _____ Calibration bottle and sponge
- _____ Beaker
- _____ Stirrer

_____ Hach One Portable pH meter (for redox measurements)

- _____ No. 1 steel paper clips
- _____ Hach ORP electrode
- _____ Prepared solution:

  10 mL 10N H_2SO_4 + 90 mL deionized/ distilled H_2O + 2.000g Fe $(NH_4)_2$ $(SO_4)_2$

  6 H_2O + 0.081g $KMnO_4$
- _____ Beaker
- _____ Stirrer

APPENDIX 5.2

SURFACE WATER QUALITY SAMPLING RECORD

SURFACE WATER QUALITY SAMPLING RECORD

PAGE ____ OF ____

FACILITY CODE _____

LOCATION ID _____ LOT CONTROL NO _____

SAMPLE ID _____ SAMPLE TYPE _____

LOG DATE _____ ACCEPTANCE CODE _____

ANALYTICAL LAB CODE _____ LOGGER CODE _____

SAMPLING PERIOD: START _____ COMPLETE _____

SAMPLING METHOD _____ DATE SENT _____

COMMENTS _____

PARAMETER MEASUREMENTS:

POTENTIAL OF HYDROGEN	pH	S.U.	_____
SPECIFIC CONDUCTANCE	Ec	umhos/cm	_____
REDOX POTENTIAL	Eh	mvolts	_____
TEMPERATURE	TMP	°C	_____
ALKALINITY ($CaCO_3$)	ALK	mg/l	_____
DISSOLVED OXYGEN	DO	mg/l	_____

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

SAMPLE TYPES:

F – FIELD R – REPLICATE
K – KNOWN A – ACID BLANK

SAMPLING METHODS:

G – GRAB SP – SUBMERSIBLE PUMP
PP – PERISTALIC PUMP O – OTHER (SPECIFY)

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQD-007 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

SURFACE WATER QUALITY SAMPLING RECORD

FACILITY CODE _____ PAGE ____ OF ____

LOCATION ID _____ **LOG DATE** _____

SAMPLING INFORMATION

WITHDRAWAL METHOD _____

FILTER SIZE _____

THERMOMETER ID _____

Ec METER ID _____

pH METER ID _____

PUMP ID _____

ALKALINITY KIT ID _____

FIELD REP _____

INSTRUMENT(S) USED _____

_____

CALIBRATION INFORMATION

DATE/TIME OF LAST Ec CALIBRATION _____

TIME OF pH CALIBRATION _____

FOR STANDARD SOLUTION pH 7, INSTRUMENT READING _____

FOR STANDARD SOLUTION pH 4, INSTRUMENT READING _____

FOR STANDARD SOLUTION pH 10, INSTRUMENT READING _____

Eh OF CALIBRATION SOLUTION _____

Eh READING IN CALIBRATION SOLUTION AFTER INSTRUMENT MEASUREMENT _____

TEMP. OF CALIBRATION SOLUTION (°C) _____

SHIPPING INFORMATION

LAB(S) SHIPPED TO: _____ _____ _____

DATE(S) SHIPPED: _____ _____ _____

METHOD OF SHIPMENT: _____ _____ _____

COMMENTS _____

_____

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQD-007 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

SURFACE WATER QUALITY SAMPLING RECORD

PAGE ____ OF ____

FACILITY CODE _____

LOCATION ID _____

LOG DATE _____

ERROR AT 4.50: $\left| \frac{X1 - X2}{X5} \right| \times 100 =$ ____%

1st = ____%

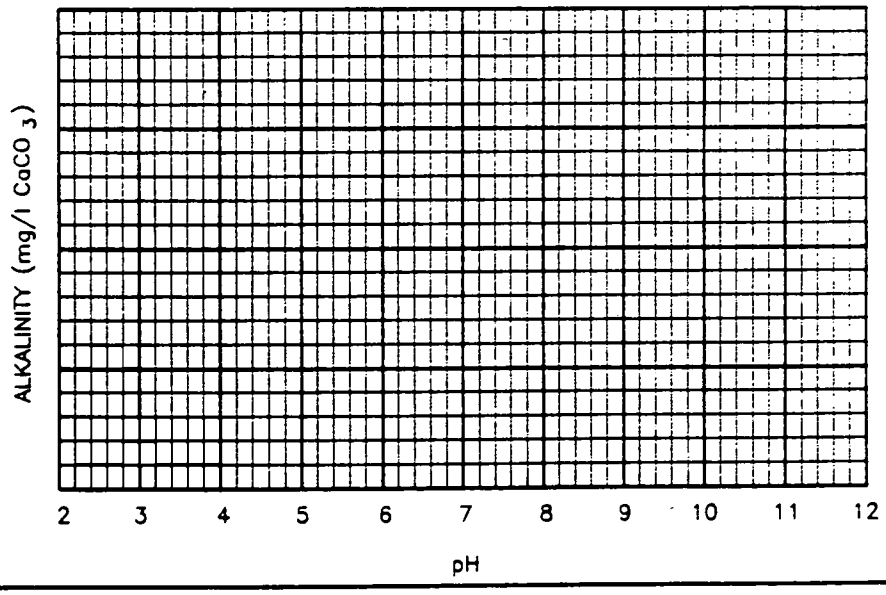
2nd = ____%

pH CHECK AFTER TITRATION

7.00 = _____

4.00 = _____

pH	ALKALINITY (mg/l $CaCO_3$)		
	1st	2nd	3rd
8.90			
8.60			
8.30			
8.05			
7.80			
7.50			
6.50			
5.70			
5.10			
4.80			
4.50			
4.25			
4.00			



COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQD-007 (3/88)

SURFACE WATER QUALITY SAMPLING RECORD

FACILITY CODE _____ PAGE ____ OF ____

LOCATION ID _____ LOG DATE _____

SAMPLE ID	TEST KIT ID	pH (S.U.)	ALKALINITY (mg/l $CaCO_3$)		UNCERTAINTY (%)
			TRUE VALUE	FIELD VALUE	

COMMENTS _____

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQD—007 (3/88)

APPENDIX 5.3

GROUNDWATER QUALITY SAMPLING RECORD

GROUNDWATER QUALITY SAMPLING RECORD

PAGE ___ OF ___

FACILITY CODE _____ **LOT CONTROL NO** _____
LOCATION ID _____ **SAMPLE TYPE** _____
SAMPLE ID _____ **ACCEPTANCE CODE** _____
LOG DATE _____ **LOGGER CODE** _____
ANALYTICAL LAB CODE _____

INITIAL GROUNDWATER DEPTH (FT) _____ SAMPLE DEPTH (FT) _____
SAMPLING PERIOD: START _____ COMPLETE _____
SAMPLING METHOD _____ DATE SENT _____

COMMENTS _____

FINAL PARAMETER MEASUREMENTS:

POTENTIAL OF HYDROGEN	pH	S.U.	
SPECIFIC CONDUCTANCE	Ec	umhos/cm	
REDOX POTENTIAL	Eh	mvolts	
TEMPERATURE	TMP	°C	
ALKALINITY ($CaCO_3$)	ALK	mg/l	
DISSOLVED OXYGEN	DO	mg/l	

TIME	TOTAL VOLUME WITHDRAWN (GALS)	TOTAL VOLUME WITHDRAWN (Bore Volume)	pH	Ec (umhos/cm)	TEMP (°C)	COMMENTS
	0.0	0.0	--	--	--	START PUMPING

ACCEPTANCE CODES: A-ACCEPTABLE R-RECONNAISSANCE U-UNACCEPTABLE N-NOT DETERMINED

SAMPLE TYPES:
F - FIELD R - REPLICATE
K - KNOWN A - ACID BLANK

SAMPLING METHODS:
G - GRAB SL - SUCTION LIFT PUMP BP - BLADDER PUMP
B - BAILER SP - SUBMERSIBLE PUMP O - OTHER (SPECIFY)
PP - PERISTALIC PUMP AL - AIR-LIFT SAMPLER

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQD-008 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

GROUNDWATER QUALITY SAMPLING RECORD

PAGE ___ OF ___

FACILITY CODE _____

LOCATION ID _____ LOG DATE _____

TIME	TOTAL VOLUME WITHDRAWN (GALS)	TOTAL VOLUME WITHDRAWN (Bore Volume)	pH	Ec (umhos/cm)	TEMP (°C)	COMMENTS

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

WQD-008 (1/88)

GROUNDWATER QUALITY SAMPLING RECORD

PAGE ___ OF ___

FACILITY CODE _____

LOCATION ID _____ LOG DATE _____

BORE VOL CALCULATION (GAL)

$$\frac{d^2\pi}{4}(h_1 - h_2) \times 7.48$$

DEPTH OF WELL (h_2) (FT) _____

DEPTH TO WATER (h_1) (FT) _____

WELL DIAMETER (FT) _____

ONE BORE VOLUME (GAL) _____

SCREENED INTERVAL (FT) _____

FIELD REP _____

INSTRUMENT(S) USED _____

_____

SAMPLING INFORMATION

WITHDRAWAL METHOD _____

FILTER SIZE _____

THERMOMETER ID _____

Ec METER ID _____

pH METER ID _____

PUMP ID _____

ALKALINITY KIT ID _____

CALIBRATION INFORMATION

DATE/TIME OF LAST Ec CALIBRATION _____

TIME OF pH CALIBRATION _____

FOR STANDARD SOLUTION pH 7, INSTRUMENT READING _____

FOR STANDARD SOLUTION pH 4, INSTRUMENT READING _____

FOR STANDARD SOLUTION pH 10, INSTRUMENT READING _____

Eh OF CALIBRATION SOLUTION _____

Eh READING IN CALIBRATION SOLUTION AFTER MEASUREMENT _____

TEMP OF CALIBRATION SOLUTION (° C) _____

SHIPPING INFORMATION

LAB(S) SHIPPED TO:	_____	_____	_____
DATE(S) SHIPPED:	_____	_____	_____
METHOD OF SHIPMENT:	_____	_____	_____

COMMENTS _____

_____

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQD-008 (3/88)

GROUNDWATER QUALITY SAMPLING RECORD

PAGE __ OF __

FACILITY CODE _____

LOCATION ID _____

LOG DATE _____

ERROR AT 4.50: $\left| \frac{X1 - X2}{XS} \right| \times 100 = ____\%$

1st = _____%

2nd = _____%

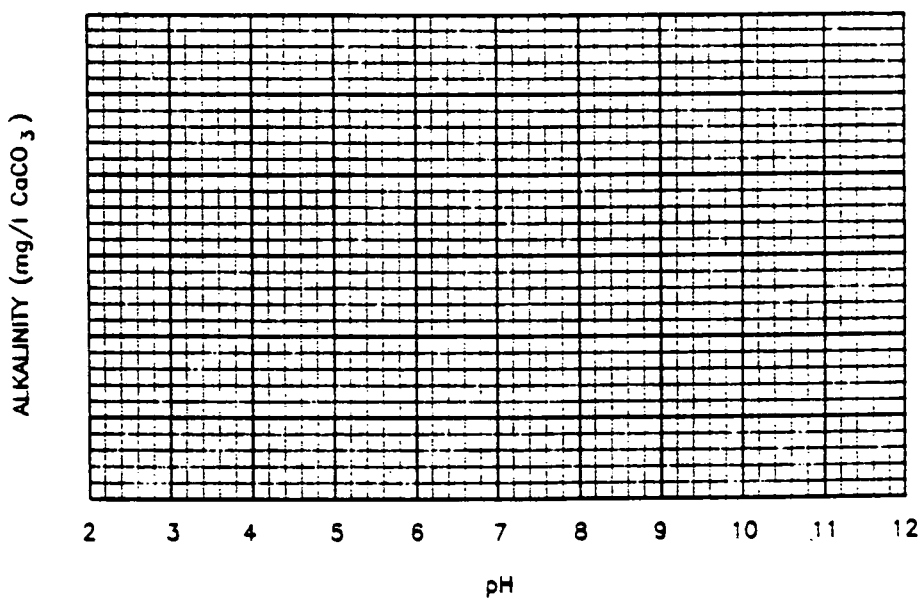
INITIAL pH _____

pH CHECK AFTER TITRATION

7.00 = _____

4.00 = _____

pH	ALKALINITY (mg/l Ca CO_3)		
	1st	2nd	3rd
8.90			
8.60			
8.30			
8.05			
7.80			
7.50			
6.50			
5.70			
5.10			
4.80			
4.50			
4.25			
4.00			



COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WQD-008 (3/88)

APPENDIX 5.4

STANDARD ELECTRICAL CONDUCTIVITY FORM

STANDARD ELECTRICAL CONDUCTIVITY DATA

FACILITY CODE _____ LOG DATE _____

LOGGER CODE _____ ACCEPTANCE CODE _____

MANUFACTURER/Ec METER ID _____

ELECTRICAL CONDUCTIVITY OF KNOWN SOLUTIONS AT 25° C:	
KNOWN (mg/l KCl)	Ec (meter)

Ec	TEMPERATURE (°C) (LAB THERMOMETER)	TEMPERATURE (°C) (Ec METER)
	0	
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	
	25	

COMMENTS _____

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

SEC-046 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.5

STANDARD ALKALINITY TEST RECORD

STANDARD ALKALINITY TEST RECORD

FACILITY CODE _____

FIELD REP _____ **LOG DATE** _____

ALKALINITY TEST KIT:

MANUFACTURER _____ ALKALINITY TEST KIT ID _____

pH METER:

MANUFACTURER _____ SERIAL NO _____

LAB CODE	STANDARD SOLUTION ID	KNOWN VALUE (mg/l $CaCO_3$)	ALKALINITY TEST VALUES (at pH endpoint = 4.5) mg/l $CaCO_3$

COMMENTS _____

COMPLETE BOLDED DATA FOR ENTRY INTO TMS
SAT-131 (2/88)

APPENDIX 5.6

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

SURFACE WATER QUALITY SAMPLING RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

3. Sample ID. A four-digit number assigned to ensure that collected data retain uniqueness.

4. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

5. Analytical Lab Code. A three-character code identifying the company responsible for preparing the standard solution.

6. Lot Control Number. A two-digit number denoting that a given set of samples should be analyzed as a lot or group. Normally, this number is not assigned by persons in the field collecting surface water samples.)

7. Sample Type. A one-character code distinguishing the type of sample collected. This classification permits the analysis of data for specific groups of samples. The codes used for water samples are listed below.

D--Duplicate	F--Field Blank
R--Replicate	T--Trip Blank
S--Spike	L--Lab Blank
K--Known	

8. Acceptance Code. A one-character code assigned by the facility manager.

9. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

10. Sampling Period. Record the starting and completion times when field measurements were taken in the 24-hr format of hours:minutes (for example, 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.). See the conversion table below.

    Start--the time that collection of water sample begins.

    Complete--the time that collection of water sample ends.

Conversion Table

Conventional Time	24-Hour Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

11. Sampling Method. A two-character code identifying the method used to collect a soil, rock, or water sample. The codes used for various water sampling methods are listed below.

B--Bailer	AL--Air Lift Sampler
C--Composite	BP--Bladder Pump
G--Grab	PP--Peristaltic Pump
R--Random	SL--Suction Lift Pump
S--Systematic	SP--Submersible Pump

12. Date Sent. The date the water sample was sent from the field collection site to the analytical laboratory in the format DD-MMM-YY (01-JAN-88).

13. Comments. Includes preservation method, acidified or nonacidified, type of acid (if acid was used to preserve water sample), and any additional information.

14. Parameter Measurements. The measurements listed below are recorded at the time the sample is collected.

    a. Potential of Hydrogen--the pH of the water sample in S.U. units at the time of collection.

b. Specific Conductance--The specific conductance of the water sample in micromhos/cm (mhos/cm) at the time of collection.

c. Redox Potential--The redox potential of the water sample in millivolts (mV) at the time of collection.

d. Temperature--The temperature of the water sample in degrees Celsius (°C) at the time of collection.

e. Alkalinity ($CaCO_3$)--The alkalinity of the water sample in milligrams per liter (mg/liter) at the time of collection.

f. Dissolved Oxygen--The dissolved oxygen content of the water sample in milligrams per liter (mg/liter) at the time of collection.

15. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

16. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

17. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

18. Withdrawal Method. The sampling device used to collect the surface water sample.

19. Filter Size. Size of filter in use.

20. Thermometer ID. The identification of the thermometer used.

21. Ec Meter ID. The control number and manufacturer of the meter used to measure the specific conductance of samples or calibration solutions.

22. pH Meter ID. The control number and manufacturer of the meter used to measure the pH of samples of standard solutions.

23. Pump ID. Identification of the pump in use.

24. Alkalinity Kit ID-identification and model or serial number of the alkalinity kit used.

25. Field Rep. Name of the field representative.

26. Instruments Used. The types of instruments used to obtain measurements, monitor air quality, or facilitate the collection of a sample or test performance.

27. Calibration Information. After performing the alkalinity titration test and immediately before sample collection, record the information listed below.

    a. Date/Time of Last Ec Calibration. Date and time that the specific conductivity meter was last calibrated in format of year:month:day/hour:minute.

    b. Time of pH Calibration. Time the pH meter was calibrated in hours:minutes.

    c. Standard Solution pH Readings. The pH readings are to be recorded as the probe is immersed in standard solutions of pH 7.0, 4.0 and 10.0.

    d. Eh of Calibration Solution. The Eh of the solution supplied by the laboratory to calibrate the specific conductance meter.

    e. Eh Reading in Calibration Solution after Measurement. The numerical value obtained after immersing the Eh probe in the standard solution.

    f. Temp of Calibration Solution (°C). The temperature of the Eh standard solution measured during the time that the probe is immersed.

28. Shipping Information. Information that includes the date, method, laboratory where the samples were shipped, and a comments section.

29. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

30. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

31. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

32. Error at 4.50. Error calculation to test the precision of the alkalinity measurement. Two tests for alkalinity are performed on the same sample, and the values are written on the pH/Alkalinity chart. The alkalinity at pH = 4.50 for test number one (x1) is subtracted from alkalinity determined in test number two (x2), and the result is divided by sx (the value of x1 or x2, whichever is smaller). The absolute value of the result is multiplied by 100 to obtain a percentage. If the calculated error is less than 10%, no further runs are necessary. If the calculated error is greater than 10%, a third test must be run. After the third test, the field sampler should use

his/her judgement to recalculate the error using the value from the third test.

33. Alkalinity (mg/l $CaCO_3$). The alkalinity of the water sample in milligrams per liter (mg/liter) at different values of pH during titration.

34. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

35. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

36. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

37. Sample ID. A four-digit number assigned to ensure that collected data retain uniqueness.

38. Alkalinity Test Kit ID. The control number used to identify the kit being utilized to measure the alkalinity of a sample or standard solution.

39. Potential of Hydrogen. The pH of the water sample in S.U. units at the time of collection.

40. Alkalinity ($CaCO_3$). Enter the field alkalinity of the water sample in milligrams per liter (mg/liter) at the time of collection in the field value column.

41. True Value. Each standard solution will be prepared to a specific alkalinity as specified by the site manager. This value will not be disclosed to the field samplers until they have completed their calibration runs. After the calibration runs are complete, the samplers must contact the site manager and report the values determined in the field. If the values are within 10% of the known value, the site manager will authorize the sampling and supply the values that are to be entered in this data entry field.

42. Field Value. The alkalinity value that samplers determined in the field on the calibration run.

43. Uncertainty (%) = $(100) \bullet \left(\frac{\text{Field Value - True Value}}{\text{True Value}}\right)$

44. Comments. Any additional information.

APPENDIX 5.6, Continued

GROUNDWATER QUALITY SAMPLING RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

3. Sample ID. A four-digit number assigned to ensure that collected data retain uniqueness.

4. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

5. Analytical Lab Code. A three-character code identifying the company responsible for preparing the standard solution.

6. Lot Control Number. A two-digit number denoting that a given set of samples should be analyzed as a lot or group. Normally, this number is not assigned by persons in the field collecting surface water samples.

7. Sample Type. A one-character code distinguishing the type of sample collected. This classification permits the analysis of data for specific groups of samples. The codes used for water samples are listed below.

D--Duplicate	F--Field Blank
R--Replicate	T--Trip Blank
S--Spike	L--Lab Blank
K--Known	

8. Acceptance Code. A one-character code assigned by the facility manager.

9. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

10. Initial Groundwater Depth. Distance in feet from the top of the casing to the surface of the water in the well. This length is determined by using the well sounder before measuring the depth of the well. Measure depth-to-water to the nearest tenth of a foot.

11. Sample depth. The depth at which the sample was taken.

12. Sampling Period. Record the starting and completion times when field measurements were taken in the 24-hr format of hours:minutes (for example, 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.). See the conversion table below.

Start--the time that collection of water sample begins.

Complete--the time that collection of water sample ends.

Conversion Table

Conventional Time	24-Hour Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

13. Sampling Method. A two-character code identifying the method used to collect a soil, rock, or water sample. The codes used for various water sampling methods are listed below.

B--Bailer	AL--Air Lift Sampler
C--Composite	BP--Bladder Pump
G--Grab	PP--Peristaltic Pump
R--Random	SL--Suction Lift Pump
S--Systematic	SP--Submersible Pump

14. Date Sent. The date the water sample was sent from the field collection site to the analytical laboratory in the format DD-MMM-YY (01-JAN-88).

15. Comments. Includes preservation method, acidified or nonacidified, type of acid (if acid was used to preserve water sample), and any additional information.

16. Final Parameter Measurements. The following measurements are recorded at the time the sample is collected.

    a. Potential of Hydrogen. The pH of the water sample in S.U. units at the time of collection.

    b. Specific conductance. The specific conductance of the water sample in micromhos/cm (mhos/cm) at the time of collection.

c. Redox Potential. The redox potential of the water sample in millivolts (mV) at the time of collection.

d. Temperature. The temperature of the water sample in degrees Celsius (°C) at the time of collection.

e. Alkalinity ($CaCO_3$). The alkalinity of the water sample in milligrams per liter (mg/liter) at the time of collection.

f. Dissolved Oxygen. The dissolved oxygen content of the water sample in milligrams per liter (mg/liter) at the time of collection.

17. The Groundwater Quality Record form contains data that are collected during well purging. These are described below.

    a. Time. The time when a field measurement of purged water was performed in the format HH:MM.

    b. Total Volume Withdrawn. Using a bucket or flow meter, the field sampler will note the number of gallons of water purged from the well at the time that a field measurement is taken. This entry is cumulative and represents the total volume of water purged before sampling may begin. A second column is provided so that the field sampler can equate gallons as bore volumes purged.

    c. pH. The pH readings of water sampled during the purging process.

    d. Ec. The specific conductance readings of water sampled during the purging process in micromhos/cm (mhos/cm).

    e. Temp (°C). The temperature of the water sampled during the purging process.

    f. Comments. Includes preservation method, acidified or nonacidified, type of acid (if acid was used to preserve water sample), and any additional information.

18. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

19. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

20. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

21. Depth of Well (h_2). Distance in feet from the top of the casing to the bottom of the well. This length can be determined by bottoming out a water level sounder against the bottom cap of the well. Measure the depth of the well to the nearest tenth of a foot.

22. Depth-to-Water (h_1). Distance in feet from the top of the casing to the surface of the water in the well. This length is determined by using the well sounder before measuring the depth of the well. Measure depth-to-water to the nearest tenth of a foot.

23. Well Diameter. The inside diameter of the well casing measured to the nearest tenth of a foot.

24. One Bore Volume. The volume of water contained in the well before purging is started. One bore volume is determined by the equation included on the form.

25. Screened Interval (Ft). Depth from the top of the casing to the midpoint of the screen or well section open to the aquifer. Well completion information must be consulted to determine the length and position of the screen.

26. Field Rep. Name of the field representative.

27. Instruments Used. Well sounding instruments and the type of system used to purge the well.

28. Withdrawal Method. The method used to sample the well.

29. Filter Size. The filter size being used.

30. Thermometer ID. The identification of the thermometer being used.

31. Ec Meter ID. The control number and manufacturer of the meter used to measure the specific conductance of samples or calibration solutions.

32. pH Meter ID. The control number and manufacturer of the meter used to measure the pH of samples of standard solutions.

33. Pump ID. Identification and model or serial number of the alkalinity kit used.

34. Alkalinity Kit ID. Identification and model or serial number of the alkalinity kit used.

35. Calibration Information. After performing the alkalinity titration test and immediately before sample collection, the information listed below will be recorded.

a. Date/Time of Last Ec Calibration. Date and time that the specific conductivity meter was last calibrated in format of year:month:day/hour:minute.

b. Time of pH Calibration. Time the pH meter was calibrated in hours:minutes.

c. Standard Solution pH readings. The pH readings are to be recorded as the probe is immersed in standard solutions of pH 7.0, 4.0, and 10.0.

d. Eh of Calibration Solution. The Eh of the solution supplied by the laboratory to calibrate the specific conductance meter.

e. Eh Reading in Calibration Solution after Measurement. The numerical value obtained after immersing the Eh probe in the standard solution.

f. Temp of Calibration Solution (°C). The temperature of the Eh standard solution measured during the time that the probe is immersed.

36. Shipping Information. Information that includes the date, method, laboratory where the samples were shipped, and a comments section.

37. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

38. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

39. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

40. Error at 4.50. Error calculation to test the precision of the alkalinity measurement. Two tests for alkalinity are performed on the same sample, and the values are written on the pH/Alkalinity chart. The alkalinity at pH = 4.50 for test number one (x1) is subtracted from alkalinity determined in test number two (x2), and the result is divided by sx (the value of x1 or x2, whichever is smaller). The absolute value of the result is multiplied by 100 to obtain a percentage. If the calculated error is less than 10%, no further runs are necessary. If the calculated error is greater than 10%, a third test must be run. After the third test, the field sampler should use his/her judgement to recalculate the error using the value from the third test.

41. Alkalinity (mg/*l* $CaCO_3$). The alkalinity of the water sample in milligrams per liter (mg/liter) at different pH values during titration.

APPENDIX 5.6, Continued

STANDARD ELECTRICAL CONDUCTIVITY FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

3. Ec Meter ID. The control number and manufacturer of the meter used to measure the specific conductance of samples or calibration solutions.

4. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

5. Acceptance Code. A one-character code assigned by the facility manager.

6. Known Value. Each standard solution will be prepared to a specific alkalinity as specified by the site manager. This value will not be disclosed to the field samplers until they have completed their calibration runs. After the calibration runs are complete, the samplers must contact the site manager and report the values determined in the field. If the values are within 10% of the known value, the site manager will authorize the sampling and supply the values that are to be entered in this data entry field.

7. Ec. The specific conductance of the water sample in micromhos/cm (mhos/cm) at the time of collection.

8. Temperature (°C). The temperature of the water sample in degrees Celsius (°C) at the time of collection.

9. Comments. Any other information.

APPENDIX 5.6, Concluded

STANDARD ALKALINITY TEST RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Field Rep. Name of the field representative.

3. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

4. Manufacturer. The company that manufactures the alkalinity test kit.

5. Alkalinity Test Kit ID. The control number used to identify the kit being utilized to measure the alkalinity of a sample or standard solution.

6. pH Meter ID. The control number and manufacturer of the meter used to measure the pH of samples of standard solutions.

7. Lab Code. A three-character code identifying the company responsible for preparing the standard solution.

8. Standard Solution ID. The control number used to identify the standard solution prepared by the quality control laboratory. The control number is assigned by the laboratory and conforms to the internal numbering system.

9. Known Value. Each standard solution will be prepared to a specific alkalinity as specified by the site manager. This value will not be disclosed to the field samplers until they have completed their calibration runs. After the calibration runs are complete, the samplers must contact the site manager and report the values determined in the field. If the values are within 10% of the known value, the site manager will authorize the sampling and supply the values that are to be entered in this data entry field.

10. Alkalinity Test Values ($CaCO_3$). The alkalinity of the water sample in milligrams per liter (mg/liter) at the endpoint of titration (pH = 4.50).

11. Comments. Includes preservation method, acidified or nonacidified, type of acid (if acid was used to preserve water sample), and any additional information.

STANDARD OPERATING PROCEDURE 2.3

SAMPLING MONITORING WELLS WITH A BLADDER PUMP

1. PURPOSE

To use a bladder pump to obtain representative groundwater samples at shallow depths that are beyond the capabilities of a peristaltic pump.

2. DISCUSSION

Each site-specific Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. The collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

For this procedure, a Middleburg squeeze-type bladder pump made completely of stainless steel and Teflon (for example, IEA, TIMCO, Well Wizard, Geoguard, and others) provides the least amount of material interference to the sample (Barcelona 1985). Analyses for a wide variety of metals, radionuclides, and organics, as well as field parameters, are valid for a sample obtained with this system. The water comes into contact with the inside of the bladder (Teflon) and the sample tubing (also Teflon) that may be dedicated to each well. Some wells may have permanently installed bladder pumps (for example, Well Wizard or Geoguard) that will be used to sample for all parameters.

Testing has shown that the nongas, contact positive-displacement pump causes less aeration in the sample than do various other retrieval methods (Barcelona 1984 and Nielsen 1985). Although no system can provide a true *in situ* sample, this method (if employed correctly) can yield a sample that is valid for numerous field measurements and chemical analyses, including organics. Although volatile organics may be collected by this method, sampling for volatile organics is so highly specialized that it is presented separately in SOP 2.8, Sampling for Volatile Organics.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel

1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurements on Groundwater and Surface Water Samples
3.1	Water Level Measurement

Monitoring wells are sampled immediately after the field measurements are taken by connecting the pump outlet tubing directly to the filter unit for filtered samples. Decrease the pump pressure so that the pressure buildup on the filter does not blow out the pump bladder or rupture the filter. Collect nonfiltered samples directly from the outlet tubing into the sample bottle.

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Ensure that permission to discharge or a containment vessel for purged water has been obtained.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells to be sampled and the appropriate decontamination area. Locate staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

C. Sample monitoring wells from least to most contaminated to reduce the possibility for cross-contamination.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

3.3. Operation

3.3.1. Procedure for Operating a Bladder Pump

A. Unlock the well and use a stiff brush to brush away any dirt or debris from around the well cap. Remove the cap.

B. Use a petroleum detection probe to determine the presence of any floating organics in the wellbore water column. The probe can also be used to determine the total depth of the well and the depth-to-water.

C. Lower the precleaned water level probe or petroleum detection probe down the well until the indicator sounds (see SOP 3.1, Water Level Measurement). Measure (to the nearest 0.01 ft) the depth-to-water from the mark on the well casing. Record this measurement in the logbook.

D. For bladder pump purging, proceed as described below.

1. Whenever a well is purged or sampled with the bladder pump, record all field measurements and chemistry determinations on either the Groundwater Level or the Groundwater Levels and Gasoline Thickness Data form, as well as the Groundwater Quality Sampling Record form.

   Copies of these forms and instructions for completing the forms are provided in SOP 2.2, Field Measurements on Ground and Surface Water Samples, and SOP 3.1, Water Level Measurement.

2. Purge the well as described in SOP 2.1, Presample Purging of Wells.

3. Attach the pump to the dedicated Teflon tubing and begin pumping.

4. To avoid pumping the well dry, reduce the pumping rate after the water level has fallen to the screened level so that the rate of water removal does not exceed the rate of recovery after the water level has fallen to the screened level from the formation.

E. Allow the well to recover to 80% of its initial volume (.8 bore volumes) before sampling. Use the water level probe to monitor well recovery. If a well is not recovering rapidly, the site manager may choose to have the well sampled before the 80% recovery has been achieved.

3.3.2. Procedure for Collecting Samples

NOTE: Consult the associated SOPs for information about collecting and measuring samples and the documentation of data.

A. Before collecting data, calibrate probes for the required measurements (see SOP 2.2, Field Measurements on Ground and Surface Water Samples).

B. To collect samples, lower the pump down the well until the bottom (intake) of the pump is just at the top of the well screen. The well-dedicated pumps should have been installed at this depth.

C. The type of analysis for which a sample is collected determines the type of bottle, preservative, holding time, and filtering requirements (see SOP 1.4, Sample Containers and Preservation).

D. Adjust the pump and pressure rates with the cycle time so that the flow is not violent. In this way, the sample can be obtained in a timely manner.

E. Do not filter the samples unless so directed by the FSP or WP.

F. If filtration is required, be sure the non-dedicated Teflon elbow is removed. Then insert the .45 micron filter end of the delivery tube. Continue to collect samples. Upon completion, remove filter and dispose of properly. Field filtration for metals must be performed within 15 minutes of collection, prior to the addition of preservative.

G. Ensure that all samples specified in the FSP or WP have been collected.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions as specified in the FSP or WP.

C. Make sure all monitoring wells are properly labeled and the location I.D. is readily visible on the protective casing.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

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5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Nongas contact bladder pump (with Teflon tubing)

_____ Compressor/batteries/battery chargers

_____ Amber glass bottles with Teflon-lined caps (0.5, 1, and 2 liters)

_____ Clear glass vials with Teflon septa (40 ml)

_____ Plastic bottles (1 liter)

_____ Teflon or other chemically inert tubing

_____ Stiff brush

_____ Concentrated H_2SO_4 (if needed)

_____ 40% NaOH (if needed)

_____ Insulated coolers

_____ Blue Ice or equivalent

_____ Padding for packaging of samples

_____ Swagelok fittings

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.4

SAMPLING MONITORING WELLS WITH A BUCKET-TYPE BAILER

1. PURPOSE

To obtain a representative groundwater sample at depths beyond the range (or capability) of suction lift pumps when volatile air stripping is of concern, well-casing diameters are too narrow to accept submersible pumps, or other difficult conditions are present.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and documentation of data will be performed as established in the associated procedures.

Bucket-type bailers are tall, narrow buckets equipped with a check valve on the bottom. A check valve allows water to enter from the bottom as the bailer is lowered and prevents its release as the bailer is raised. A bailer with a controlled flow, bottom-emptying assembly is recommended because this type of bailer greatly increases the ease with which water samples can be discharged to the sample containers (especially VOA vials).

Because of the aeration associated with most other recovery systems, the bucket-type bailer is the preferred method for collecting samples that are susceptible to volatile component air stripping or degradation. Samples can be recovered with a minimum of aeration if care is taken to gradually lower the bailer until it contacts the water surface and to allow it to sink as it fills. Teflon is generally the best construction material, but other materials (like PVC or stainless steel) are acceptable if compatible with the designated sample analysis outlined in the FSP or WP. The primary disadvantages of bailers are their limited sample volume and inability to collect discrete samples from a depth below the water surface.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activity. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel

1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide for Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurements on Ground and Surface Water Samples
2.8	Sampling for Volatile Organics
3.1	Water Level Measurement

3.2. **Preparation**

3.2.1. **Office**

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Ensure that a containment system is available to collect purged water, as appropriate.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells to be sampled and the appropriate decontamination area. Locate staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

C. Sample monitoring wells from least to most contaminated to reduce the possibility for cross-contamination.

3.3. Operation

3.3.1. Procedures for Operating a Bucket-Type Bailer

A. Unlock the well and use a stiff brush to brush away any dirt or debris from around the well cap. Remove the cap.

B. Use a petroleum detection probe to determine the presence of any floating organics in the wellbore water column. The probe can also be used to determine the total depth of the well and the depth-to-water.

C. Lower the precleaned water level probe or petroleum detection probe down the well until the indicator sounds (see SOP 3.1, Water Level Measurement). Measure (to the nearest 0.01 ft) the depth-to-water from the mark on the well casing. Record this measurement in the logbook.

D. Collect a sample from the first bailer if specified in the FSP or WP. Otherwise, purge the well as described in SOP 2.1, Presample Purging of Wells, or SOP 2.3, Sampling Monitoring Wells with a Bladder Pump.

E. Allow the well to recover to 80% of its initial volume (.8 bore volumes) before sampling. Use the water level probe to monitor well recovery. If a well is not recovering rapidly, the site manager may choose to have the well sampled before the 80% recovery has been achieved.

F. Set up the reel and tripod wellhead and attach the bailer to the cable or line.

G. Slowly lower the bailer into the well until it contacts the water surface.

H. Allow the bailer to sink and fill with a minimum of surface disturbance.

I. Slowly raise the bailer out of the well. Do not allow the bailer line to contact the ground, either by coiling it on a plastic sheet or by looping it from arm to arm as the line is extracted from the well. The use of a reel greatly simplifies this process.

3.3.2. Procedure for Collecting Samples

NOTE: Also consult the associated SOPs for information on collecting and measuring samples and the documentation of data.

A. Whenever a well is sampled, record all field measurements and chemistry determination on either the Groundwater Level or the Groundwater Levels and Gasoline Thickness Data form, as well as the Groundwater Quality Sampling Record form.

   Copies of these forms and instructions for completing the forms are provided in SOP 2.2, Field Measurements on Ground and Surface Water Samples, and SOP 3.1, Water Level Measurement.

B. If a bailer with a controlled flow, bottom-emptying assembly is being used, connect the flow control device (stop-cock valve) to the bottom of the bailer, and open the stop-cock to allow water to gently flow into the sample containers. If a controlled flow device is not being used, tip the bailer to allow a slow discharge to flow gently down the inside wall of the sample bottle with minimal entry turbulence.

C. Filter or preserve the sample as specified in the FSP or WP. If filtration is required, use a 0.45 micron filter assembly; samples mustn be filtered within 15 minutes of collection prior to the addition of preservative.

D. Repeat the necessary steps as needed to acquire a sufficient volume of sample (see SOP 1.4, Sample Containers and Preservation).

   NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

E. Use a Teflon-lined cap if necessary. Secure the cap tightly.

F. Thoroughly decontaminate the bailer before sampling the next well, according to specific laboratory instructions or the general guidelines in SOP 1.6, General Equipment Decontamination. In some cases, especially where trace analysis is desired, it may be prudent to use a dedicated bailer for each well.

3.4. **Postoperation**

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all monitoring wells are properly labeled and the location ID is readily visible on the protective casing.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and that instructions for sample analyses are clearly understood.

4. SOURCES

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Ford, Patrick J., Paul J. Turina, and Douglas E. Seely. 1984. "Characterization of Hazardous Waste Sites - A Methods Manual", in Vol. II of Available Sampling Methods. 2d ed. U.S. Environmental Protection Agency report EPA/600/4-84/076. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Teflon bailers

_____ Amber glass bottles with Teflon-lined caps (0.5, 1, and 2 liters)

_____ Clear glass vials with Teflon septa (40 ml)

_____ Plastic bottles (1 liter)

_____ Stiff brush

_____ Concentrated H_2SO_4 (if needed)

_____ 40% NaOH (if needed)

_____ Insulated coolers

_____ Blue Ice or equivalent

_____ Padding for packaging of samples

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.7

SAMPLING COMMERCIAL/MUNICIPAL/DOMESTIC WELLS

1. PURPOSE

To define guidelines for field personnel to follow in sampling commercial, municipal, and domestic wells.

2. DISCUSSION

Water samples may be collected from industrial, public, and private water supply wells to support the site characterization of a facility. The Field Sampling Plan (FSP) or Work Plan (WP) contains site-specific sampling instructions and locations, as well as specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the analyses that are to be performed. The collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

In most instances, details concerning well installation and development will be either unknown or fragmentary. Procedures for sample collection must be carefully followed and well documented so that any questionable data can be attributed to factors beyond the control of the FSP or WP. Noninert materials in the well and pipes can alter the chemistry of the sample. Therefore, it is important to collect the sample as close to the wellhead as possible (Freeze 1979).

Care must be taken to promote strong community relations with private, public, and industrial neighbors in the vicinity of the facility. Successful completion of well sampling by following an SOP will impress neighbors with the professionalism and quality management of the program. Following properly documented field procedures will ensure that privately owned wells do not become damaged or contaminated through sampling activities.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation

1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurement on Ground and Surface Water Samples
2.6	Sampling Monitoring Wells with a Peristaltic Pump
2.8	Sampling for Volatile Organics
3.1	Water Level Measurement

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Contact the well owner and set up a time to collect water samples and perform field chemistry measurements. If possible, arrange for

commercial, municipal, and domestic wells to be sampled before the monitoring wells.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

Consider specific sampling protocol on an individual basis; each sampling well will have a different pump, construction material, pipe, and access point for sample collection. Consult the FSP or WP for specific instructions for each well.

Groundwater samples will be grabbed from a discharge pipe or water faucet. Under no circumstances will the field technician pull a pump or insert a sampling device directly into a well unless specified in the FSP or WP or with documented approval from the site manager.

For collection of groundwater from public and private water supply wells, proceed as outlined below.

3.3.1. Preliminary Arrangements

A. Whenever a well is purged or sampled, record all field measurements and chemistry determinations on either the Groundwater Level or the Groundwater Levels and Gasoline Thickness Data form, as well as the Groundwater Quality Sampling Record form. Copies of these forms and instructions for completing the forms are provided in SOP 3.1, Water Level Measurement, and SOP 2.2, Field Measurements on Ground and Surface Water Samples, respectively.

B. If possible, discuss your activity with the well owner and set up the sampling vehicle in a location that will cause no inconvenience to anyone.

C. Determine if the discharge pipe or water faucet is on a water treatment system of some type (water softener, for example). Note this in the comments section of the Groundwater Quality Sampling Record (see SOP 2.2, Field Measurements on Ground and Surface Water Samples).

D. If possible, take a water level measurement (see SOP 2.1, Water Level Measurement).

E. If well documented, well completion data can be obtained. Calculate the bore volume as described in SOP 2.1, Presample Purging of Wells.

3.3.2. Sampling Procedures

A. Connect the appropriate sampling apparatus (cleaned tubing, connectors, and flow-through bath) to the discharge pipe. Obtain the sample as close as possible to the source and directly from the wellhead when feasible.

B. Set up and calibrate the equipment.

C. Begin withdrawing water from the well. If possible, run the water for at least 10 min to ensure that pipes have been thoroughly flushed. Record the volume of water purged.

D. Perform field measurements according to SOP 2.2, Field Measurements on Ground and Surface Water Samples, and SOP 2.8, Sampling for Volatile Organics.

E. Collect water samples according to SOP 1.4, Sample Containers and Preservation.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

F. Samples collected for dissolved metals must be filtered; analysis for total metals must not be filtered.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

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5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Teflon tubing

_____ Pump fittings

_____ Water level probe

_____ Calibrated bucket

_____ Stopwatch

_____ Sample containers and preservatives

_____ Foam sleeves, vermiculite coolers, and Blue Ice (or equivalent)

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 2.8

SAMPLING FOR VOLATILE ORGANICS

1. PURPOSE

To outline procedures for collecting a representative groundwater sample and transporting it from its original environment to the laboratory for analysis of trace volatile organics.

2. DISCUSSION

The growing concern over the past several years about low levels of volatile organic compounds in water supplies has led to the development of highly sophisticated analytical methods that can provide detection limits at parts-per-trillion levels. Although laboratory methods are extremely sensitive, well controlled, and quality assured, they cannot compensate for a poorly collected sample. The collection of a sample should be as sensitive, highly developed, and quality assured as the analytical procedures.

A sample to be analyzed for dissolved volatile organics must be collected with minimal disturbance of the sample to limit aeration, which would cause a loss of volatiles from the sample.

Sample retrieval systems suitable for the valid collection of volatile organic samples are positive-displacement bladder pumps; reciprocating piston-type, submersible pumps; gear-driven, submersible pumps; syringe samplers; and bailers (Barcelona 1984; Bennett 1988; Nielsen 1985). Field conditions and other considerations will limit the choice of system. The focus of concern must be to provide a valid sample for analysis, one that has been subjected to the least amount of turbulence possible.

Materials of construction for bladders, pumps, bailers, and tubing are limited to stainless steel, Teflon, and glass. The tendency of organics to leach into and out of many materials makes the selection of materials critical for these trace analyses. The use of plastics, for example, Tygon, must be avoided. There are numerous ways of introducing foreign contaminants into a sample; these must be avoided by following strict sampling procedures and using only trained personnel.

Treatment of the sample with sodium thiosulfate preservative is required only when there is residual chlorine in the water. Residual chlorine could cause free, radical chlorination and change the identity of the original contaminants.

Holding time for the analysis of volatiles is seven days. It is imperative that the samples are shipped or delivered to the analytical laboratory daily. The bottles must be shipped on their sides to aid in maintaining the airtight seal during shipment, with adequate packing and cooling to ensure that they arrive intact. The sensitivity of the analysis and the fragility of the samples require that all volatile samples are collected in duplicate.

The Field Sampling Plan (FSP) or Work Plan (WP) contains site-specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the analyses that are to be performed. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to the Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
2.1	Presample Purging of Wells
2.2	Field Measurement on Ground and Surface Water Samples
2.3	Sampling Monitoring Wells with a Bladder Pump
2.4	Sampling Monitoring Wells with a Bucket-Type Bailer

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Obtain appropriate discharge permits or containment vessels for purged water.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Locate monitoring wells to be sampled and the appropriate decontamination area. Locate the staging area and areas for managing purged water and expendable sampling materials. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP). Perform other sampling tasks before collecting the volatile samples (see SOP 2.1, Presample Purging of Wells; SOP 2.2, Field Measurements on Ground and Surface Water Samples; and SOP 2.8, Sampling for Volatile Organics).

C. Sample monitoring wells from least to most contaminated to reduce the possibility for cross-contamination.

3.3. Operation

3.3.1. Preliminary Determinations

A. Floating Organics. If floating organics are of concern (as determined in the FSP or WP and by field measurement for floating organics), obtain the sample with a bucket-type or bottom-valve bailer (see SOP 2.4, Sampling Monitoring Wells with a Bucket-Type Bailer).

B. Purging. Purge the well before sampling, as specified in the FSP or WP and according to SOP 2.1, Presample Purging of Wells. Ensure that the well was not pumped dry and that high flow rates were not employed to cause turbulence in the formation.

C. Residual Chlorine. Using the Hach Field Test Kit for Chlorine, determine if there is residual chlorine in the water to be sampled. If there is, treat the sample vial with a crystal of sodium thiosulfate before sample collection (see SOP 1.4, Sample Containers and Preservation).

3.3.2. Sample Retrieval

A. Bladder Pumps. Using a nongas, contact positive-displacement bladder pump is often mandated when dedicated pumps have been installed on wells. These bladder pumps are also suitable for shallow wells (less than 100 ft). They are somewhat difficult to clean, but can be used with well-dedicated sample tubing to avoid some cleaning. These pumps require a power supply and a compressed gas supply (or compressor). They may be operated at variable flow and pressure rates, which makes them ideal for both purging and sampling.

1. Increase the cycle time and reduce the pressure to the minimum that will allow the sample to come to the surface.

2. Open both vials, set caps in a clean place, and collect the sample during the middle of the cycle. Collecting both samples at the same time provides more similar samples than those collected at different times, but may be difficult. At a minimum, collect two samples from consecutive discharge cycles.

3. Holding the edge of the sample line at the top edge of the sample vial, allow the water to run down the side into the vial. Do not allow the water to drop or fall into the vial; avoid splashing. The discharge rate cannot exceed 100 mL/minute.

4. Fill the vials just to overflowing. Do not rinse the vials or excessively overflow them. There should be a convex meniscus on the top of the vials.

5. Be sure the caps have not been contaminated (splashed) and carefully cap the vials. Place the caps directly over the top and screw down firmly. Do not overtighten and break the cap.

6. Invert the vials and tap gently. Observe vials for at least 10 sec. If an air bubble appears, discard the sample and begin again. It is imperative that no entrapped air is in the sample vial.

7. Immediately place the vials in the protective foam sleeve and place into the cooler. They should be on their sides, rather than straight up.

8. Ship or deliver samples to the laboratory daily. Ensure that the samples are iced, but do not allow them to freeze.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Water Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

B. Reciprocating Piston-Type, Submersible Pumps. These systems are portable, self-contained, and capable of delivery flow rates of 30 gallons per hour at lifts up to 500 ft. The pump fits into 2-inch wells, which is the most common monitoring well diameter. The flow rate of the pump is

varied by increasing or decreasing the driving pressure supplied to the pump from a compressed air container. The gas driving the pump does not contact the sample being purged, making this type of pump the preferred tool to collect samples for volatile organic analyses in deep wells. The samples are collected as described in steps 2-8 of Section 3.3.2.A.

C. Gear-Driven, Submersible Pumps. These pumps are not as complicated or expensive as the bladder pumps. They provide comparable samples and are often easier to handle and clean than are other pumps. However, they do not have good control of flow rate, and more care must be exercised when sampling with them.

   Collect the sample as described in steps 2-8 of Section 3.3.2.A. Use more care with this kind of a pump because the flow rate is not controllable and there is a greater potential for splashing and aeration of the sample.

D. Syringe Samplers. Only a limited number of commercial, syringe-type samplers are available (two are manufactured by IEA and TIMCO). Although some homemade devices apparently provide good, quality samples for volatile analysis, these devices are severely limited in sample volume and are specific to sampling for volatiles. Essentially, they operate with an evacuated chamber that is lowered down the well and allowed to fill from the pressure of the water. The entire mechanism is then brought to the surface with the sample. The sample can then be transferred to a sample vial, or the entire unit may be sent as the sample container.

   1. If necessary, evacuate the syringe and lower the sampling device to just below the well screen.

   2. Remove the constriction from the device and allow the syringe to fill with sample, applying slight suction.

   3. Bring unit to the surface. If necessary, transfer the sample to vials (see steps 2-8 of Section 3.3.2.A).

E. Bailers. The positive-displacement, volatile-sampling bailer by GPI is the most appropriate bailer to collect water samples for volatile analysis. Other bailer types (messenger and bottom fill) are less desirable, but may be mandated by cost and site considerations. Generally, bailers can provide an acceptable sample, provided that the sampling personnel use extra care in the collection process.

   1. If using the GPI bailer, insert a volatile organic analysis (VOA) vial into the clamp and assemble the unit.

   2. Securely attach the bailer to the cable that is on a reel.

   3. Lower the bailer slowly and gently into the well, taking care not to shake the casing sides or splash the bailer into the water.

   4. Check the reel meter to note the location of the bailer in the well. Stop when the bailer reaches the screened interval.

5. Retrieve the bailer from the well slowly and gently, avoiding bumping and splashing.

6. Once the bailer reaches the surface, detach the bailer from the cable. Repeat steps 1-6 for the second vial.

7. Carefully open the GPI bailer unit and remove the vial. If using a conventional bailer, skip the next step. If using a GPI bailer, repeat steps 1-7 to collect the duplicate sample.

8. Begin slowly pouring from the bailer; collect the duplicate samples from the midstream sample.

9. Proceed as described in steps 2-8 of Section 3.3.2.A.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions as specified in the FSP or WP.

C. Make sure all wells are properly labeled and the location ID is readily visible on the protective casing.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

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5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Teflon stainless steel bladder pump

_____ Teflon stainless steel gear-driven submersible pump

_____ Syringe sampler; stainless steel, Teflon, or glass

_____ Teflon stainless steel bailer (positive-displacement or point-retrieval)

_____ Teflon or other chemically inert tubing

_____ Fittings for pump

_____ 40-ml amber glass vials; Teflon-lined septa

_____ Hach field kit for chlorine

_____ $Na_2S_2O_4$ crystals

_____ Foam sleeves, coolers, and Blue Ice (or equivalent)

_____ Cable, reel, and tripod

_____ Air compressor or bottled nitrogen

_____ Plastic sheet

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 3.1

WATER LEVEL MEASUREMENT

1. PURPOSE

To determine the depth-to-water in an open borehole, cased borehole, monitoring well, or potentiometer.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) for the site contains specific details about the procedures, equipment, and frequency of measurements for this SOP. The documentation of water level measurements, air quality for the health and safety of field personnel, and equipment calibration will be performed as described in the associated procedures.

Generally, water level measurements from boreholes, potentiometers, or monitoring wells are used to construct potentiometric surface maps. Therefore, water level measurements at a given site should be collected within a 24-hr period. Under the following conditions, all measurements must be taken within a shorter interval.

- A range of observed changes between wells that is too large to be indicative of natural gradient groundwater
- Drastic atmospheric pressure changes
- Tidally influenced aquifers
- Aquifers affected by river stage, impoundments, or unlined ditches
- Aquifers stressed by intermittent pumping of production wells
- Aquifers being actively recharged because of precipitation event

The device used to measure water levels should be adequate to attain an accuracy of 0.01 ft. Generally acceptable devices are listed below.

- Steel tape
- An electric sounder
- A petroleum product probe
- A reflection sounder
- A transducer
- An airline

Place a survey mark on the casing as a reference measuring point. The mark should be permanent; a groove cut with a file is recommended. Mark another measuring reference on the grout apron and guard pipe. Document the measuring point in the logbook and on the data form.

Allow water levels in potentiometers and monitoring wells to stabilize for a minimum of 24 hrs after well construction and development before measurements are taken. Recovery may take longer in wells completed in tight formations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
3.3	Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment. Be sure the water level measuring device has been calibrated.

E. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the most recent calibration date for the water level measuring device in the logbook.

3.2.3. Field

A. Locate monitoring wells to be measured and the appropriate decontamination area. Check decontamination zones and barricades to public access.

B. Decontaminate all sampling equipment before taking the first measurement and between each well (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

C. When taking a number of water level measurements, it is preferable to start at those wells that are the least contaminated and proceed to those wells that are the most contaminated.

3.3. Operation

A. Whenever a water level is measured, enter a description of the sampling location and record of the measured value onto the Groundwater Level Data (Appendix 5.2) or the Groundwater Levels and Gasoline Thickness Data (Appendix 5.3) form. Use the latter when a petroleum or gasoline product is floating on the static water in the well. Fill out the forms as described in Appendix 5.4, Data Form Completion.

B. Place equipment on a Teflon or plastic sheet.

C. Remove locking well cap. Note the location, time of day, and date in the logbook and on the appropriate data form.

D. Remove the well casing cap.

E. If required by site-specific conditions, monitor the headspace of the well with a photoionization detector or a flame ionization detector to determine the presence of volatile organic compounds and record the measurements in the logbook or on appropriate forms. For the use of air monitoring instruments, see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector.

F. Lower an electric, water level measuring device or equivalent (for instance, permanently installed transducers or airline) into the well until the water surface is encountered.

G. Measure the distance from the water surface to the reference measuring point on the well casing and record this distance in the logbook and on the data form in the comments column. Measurements will be taken to 0.01 ft. The reference points will be established in relation to an established National Geodetic Vertical Datum (NGVD). If the well casing is damaged, measure from some other permanently fixed structure or the ground surface and note this modification in the logbook and data form.

H. Measure depth-to-water at least twice or until results are reproduced and record each measurement in the logbook and in the comments column of the data form. Record the reproduced measurement in the depth-to-water column on the field form.

I. Lower the water level measuring device until the bottom of the well is encountered. Record the depth. Repeat procedure until a consistent depth of the well is obtained.

J. Remove all downhole equipment; replace the well casing cap and locking steel caps.

K. Rinse all downhole equipment and store for transport to the decontamination area.

L. Note any physical changes (like erosion or cracks) in the protective concrete pad or variation in the total depth of the well in the logbook.

M. If using pressure transducers to measure water levels, refer to SOP 3.3, Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions as specified in the FSP or WP.

C. Make sure the monitoring well is labeled or the borehole is properly staked and the location ID is readily visible on the location stake or protective casing.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

EPA. 1986. "RCRA Groundwater Monitoring Technical Enforcement Guidance Document.: U.S. Environmental Protection Agency unnumbered document. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1 Equipment and Supplies Checklist

5.2 Groundwater Level Data Form

5.3 Groundwater Levels and Gasoline Thickness Data Form

5.4 Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Site map showing well locations

_____ Steel tape and blue surveyor's chalk

_____ Electric sounder

_____ Reflection sounder

_____ Transducer and data logger

_____ Airline

_____ Petroleum product detection probe

_____ Plastic or Teflon sheeting

_____ Decontamination solutions

_____ Keys to well locks

_____ Tape measure graduated in 0.01 ft

_____ Nonwater-soluble black ink pens

APPENDIX 5.2

GROUNDWATER LEVEL DATA FORM

GROUNDWATER LEVEL DATA

PAGE ____ OF ____

FACILITY CODE _____ LOGGER CODE _____

LOG DATE _____ ACCEPTANCE CODE _____

LOCATION ID	LOG TIME (HH:MM)	DEPTH TO WATER (FT) *	COMMENTS

* MEASUREMENT REFERENCE POINT FROM ☐ TOP OF GROUND OR ☐ TOP OF CASING

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

GWD–012 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.3

GROUNDWATER LEVELS AND GASOLINE THICKNESS DATA FORM

GROUNDWATER LEVELS AND GASOLINE THICKNESS DATA

FACILITY CODE _____ LOGGER CODE _____

LOG DATE _____ TYPE OF PROBE _____

ACCEPTANCE CODE _____

LOCATION ID	LOG TIME (HH:MM)	DEPTH TO WATER (FT) *	DEPTH TO GAS (FT)	COMMENTS

*MEASUREMENT REFERENCE POINT FROM ☐ TOP OF GROUND OR ☐ TOP OF CASING

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

TYPES OF PROBES: ROD—TEFLON ROD WITH PASTE OWI—OIL WATER INTERFACE PROBE OTH—OTHER (SPECIFY)

COMPLETE BOLDED DATA FOR ENTRY INTO TMS
CRO-646 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

GROUNDWATER LEVEL DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Logger Code. Three-character code identifying the company responsible for performing field measurements.

3. Log Date. The date when the measurement was made in the format DD-MMM-YY (01-JAN-88).

4. Acceptance Code. One-character code assigned by the installation manager.

5. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

6. Log Time. Using the 24-hr clock, time when the water level measurement was recorded. Must be in the format of hours:minutes.

Conversion Table

Conventional Time	24-Hour Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

7. Depth-to-Water. The water level measurement in feet, tenths of feet, or hundredths of feet, depending on instructions provided in the FSP or WP.

8. Measuring Reference Point. Inscribe, ink, or paint a permanently marked measuring point on the PVC well casing from where all water level measurements for individual wells should be measured. This provides consistency in future water level measurements. If the measuring point is missing, record the water level relative to the ground surface, but mark the casing at the point the measurement was made. Record the distance from the new mark to the ground surface on the data form and in the logbook and describe the new measuring point in the comments column of the data form.

9. Comments. Any additional information.

GROUNDWATER LEVELS AND GASOLINE THICKNESS DATA FORM

Items 1 through 9 of the Groundwater Level Data form also apply to this form. In addition, use the following instructions that are unique to investigations where a gasoline (or other petroleum) product is floating on the water in the well.

1. Depth-to-Gas. The level measurement in feet, tenths of feet, or hundredths of feet, depending on instructions provided in the FSP or WP.

2. Type of Probe. The manufacturer's name and serial number (if available) of the petroleum probe being used.

STANDARD OPERATING PROCEDURE 3.3

OPERATIONAL CHECK OF PRESSURE TRANSDUCERS USED IN MEASURING WATER LEVELS IN WELLS

1. PURPOSE

To describe procedures for conducting office and field checks of pressure transducers.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) for the site contains specific details about the frequency of measurements for this SOP. The documentation of water level measurements will be performed as described in the associated procedures. Pressure transducers measure hydrostatic pressure, which can then be converted to groundwater elevations. A transducer measures pressures over a specific range of submergence. Outside this range, measurements will not be accurate. If it is submerged more than two times its design range or subjected to negative pressures, the transducer can be damaged. This SOP describes a method to ensure that the transducer is working properly.

Take several precautions when using transducers of submergence. Vent the transducer cable so that the temperature and barometric pressure will not cause variations in the transducer reading. If the vent port is plugged, inaccurate readings will result. If water enters the vent and flows downward into the transducer, the transducer may be destroyed. The transducer cable is susceptible to physical damage (for example, abrasions on sharp well casings) and chemical degradation from solvents. If the cable is damaged and submerged, the transducer may be destroyed or inaccurate readings may result.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
3.1	Water Level Measurement

3.2 Aquifer (Slug) Testing

3.4 Aquifer Pumping Test

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Ensure the proper operation of the electronic data logger and pressure transducer. Review guidelines in the operator's manual for the electronic data logger. Be sure that the data logger or its battery pack is fully charged. Using a 3- to 4-ft column of water (for example, capped PVC casing), test the response of the electronic data logger and pressure transducer. Conduct a test for the proper depth response and a test for the drift of readings in this column.

Depth Response Test

1. Mark the length of the transducer cable at measured intervals appropriate for the column of water. Using a 4-ft column of water, for example, mark the cable with tape at 1-ft intervals (for a 3-ft length), beginning at the transducer end.

2. Lower the transducer and cable to the bottom of the water column.

3. Connect the cable to the electronic data logger and begin the logging sequence.

4. Wait one minute and raise the transducer a measured length. Wait one more minute.

5. Continue raising the transducer cable to the measured segments and logging the results for one minute until all segments have been measured.

6. Check the lengths recorded on the data logger against the measured lengths. If the difference is greater than 2% to 5% of the measured length, return the transducer to the manufacturer for calibration.

Drift Test

1. Lower the transducer into the water column and tape to the edge of the column.

2. Connect the transducer cable to the electronic data logger and begin a 15-min logging sequence.

3. Check the results for noticeable drift of the depth measurement.

4. Notify the manufacturer if an unacceptable drift is occurring.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms for use during the field water level measurement task (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes and location IDs used in the completion of data forms.

3.2.3. Field

A. Locate the monitoring wells where the pressure transducers will be calibrated and locate the appropriate decontamination areas.

B. Assemble the testing equipment.

C. Decontaminate the transducer and cable as specified in the Sampling Plan and SOP 1.6, General Equipment Decontamination.

D. Make an initial water level measurement for the calibration monitoring well using a tape or water level sounder according to SOP 3.1, Water Level Measurement.

E. Before beginning the calibration, record the information and enter it into the electronic data logger. The type of information may vary, depending on the model used. When using different models, consult the operator's manual for the proper data entry sequence to be used. The following data are entered into the Enviro-Labs Model DL-120-MCP Data Logger as an example.

1. Baud rate

2. Station ID

3. Date (YY/MM/DD)

4. Time (HH:MM:SS)

5. Scale factors for each channel

6. Set logging sequence (use a logging sequence that will last for at least 3 min).

3.3. Operation

A. Cover sharp edges of the well casing with duct tape to protect the transducer cables.

B. Repeat the depth response test and drift test described in Section 3.2.1.E.

C. Continue the water level measurement task specified in the FSP or WP (for example, slug test or pumping test).

3.4. Postoperation

3.4.1. Field

A. After completing the aquifer test, decontaminate the transducer and cable according to SOP 1.6, General Equipment Decontamination. Do not use solvents to decontaminate the transducer cable.

B. Complete the shutdown of the electronic data logger:

C. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

3.4.2. Documentation

A. Complete original calibration documentation (data logger printout).

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

3.4.3. Office

A. Deliver documentation to the site manager for technical review. He/she will review and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

D. Arrange for the repair of any transducers that were damaged or could not be calibrated.

4. SOURCES

Enviro-Labs, Inc. 1986. "Operation manual: El-200 Groundwater Monitoring System with Model EL-120-MCP Data Logger," April 1986. Milford, New Hampshire.

In-Situ, Inc. 1984. "Owner's Manual: Hydrologic Analysis System, Model SE200," April 1984. Laramie, Wyoming.

5. APPENDIX

5.1 Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Electronic data logger

_____ Pressure transducer and cable

_____ Water level sounder

_____ Tape measure graduated in 0.01 ft

_____ Capped PVC casing

_____ Duct tape

_____ Clean water

STANDARD OPERATING PROCEDURE 3.4

AQUIFER PUMPING TEST

1. PURPOSE

To define procedures to conduct pumping tests for the *in situ* determination of the hydraulic properties of water-bearing soils and rocks.

2. DISCUSSION

An aquifer test is a controlled field experiment to determine the hydraulic properties of water-bearing soils and rocks. Groundwater flow varies in space and time and depends on the hydraulic properties of the saturated, odorous, or fractured medium and the boundary conditions imposed on the groundwater system. Pumping tests provide results that are more representative of aquifer characteristics than those predicted by slug tests, can be used to determine the hydraulics of interaquifer flow, require a greater degree of activity and expense than slug tests, and are not always justified for all levels of investigation. As an example, slug tests may be acceptable at the reconnaissance level, but pumping tests are usually performed as part of a feasibility study in support of designs for aquifer reclamation.

The rationale for the selection of a specific program of aquifer testing is contained in the Field Sampling Plan (FSP) or Work Plan (WP) for the site. Refer to the FSP or WP for the duration of the pumping test, the location of the observation well, and the data to be collected. Collection of measurements and documentation of data will be performed as described in the associated procedures.

Aquifer characteristics that may be obtained from pumping tests include hydraulic conductivity (K), transmissivity (T), specific yield (Sy) for unconfined aquifers, and storage coefficient (S) for confined aquifers and the vertical hydraulic conductivity of confining layers. Also, the occurrence and position of recharge or impermeable boundaries can be identified. These parameters can be determined by graphical solutions and computerized programs.

3. PROCEDURES

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

3.1. Associated Procedures

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.1 Water Level Measurement

3.3 Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Ensure that permission to discharge is obtained or a containment system is available for collecting water that will be pumped during the test. This is especially important for wells that may produce contaminated water.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes and location IDs used in the completion of data forms.

3.2.3. Field

A. Obtain the following information, equipment, and equipment modifications necessary to conduct a pumping test and check the equipment for proper functioning. Obtain assurances from the drilling contractor concerning the completion of the well installation and development and the availability of the necessary equipment to conduct the pumping test. The drilling contractor is responsible for completing the following tasks and supplying the equipment listed below before the arrival of field personnel.

1. Drilling, installing, completing, and developing all pump wells and one observation well to the proper specifications identified in the FSP or WP.

2. Installing a submersible or turbine pump. The pumping well should be properly developed before testing.

3. Installing a totalizer meter and a flow meter in the discharge line of the pump well to accurately measure and monitor the volume and role of discharge.

4. Installing sufficient pipe to transport the discharge from the pumping well away from the area to prevent infiltration in the pumped zone.

5. Installing a gate valve on the discharge pipe to control the pumping rate.

6. Placing an outlet near the well head, but past the totalizer and flow meters, for water quality determination and sampling.

B. Calibrate all gauges, transducers, flow meters, and other equipment used in conducting pumping tests before use. Obtain copies of the documentation for instrumentation calibration and file them with the records of test data. Calibration records should contain laboratory measurements. If necessary, perform any onsite zero adjustment or calibration. Where possible, check all flow-measurement devices onsite using a container of measured volume and a stopwatch. Verify the accuracy of the meters before testing proceeds.

C. If funds are available, it is normally advisable to monitor pretest water levels at the test site for about one week before performing the test. This can be accomplished by using a continuous recording device like a Stevens Recorder. These records establish the barometric efficiency of the aquifer. The records also help determine if the aquifer is experiencing an increase or decrease in head with time caused by recharge or pumping in the nearby area or diurnal variations. Record changes in barometric pressure during the test (preferably with an onsite barograph) in order to correct water levels for any possible fluctuations that may occur from changing atmospheric conditions. Project the pretest water level trends for the duration of the test. These trends or barometric changes may be used to correct water levels during the test so that they are representative of the hydraulic response of the aquifer from pumping the test well.

D. The duration of the test is determined by the needs of the project and the aquifer properties. In general, longer tests produce more definitive results. If the budget permits, a duration of one to several days is desirable, followed by a similar period of monitoring the recovery of the water level. A knowledge of the local hydrogeology and a clear understanding of the overall objectives of the FSP or WP are necessary in determining the direction of the test. The effect of any hydrogeologic boundaries should be considered. There is no need to continue the test if the water level becomes constant with time. This normally indicates that a hydrogeologic source has been intercepted and that additional useful information will not be collected by continued pumping. One simple test for determining the adequacy of data is when the log time compared to drawdown for the most distant observation well begins to plot as a straight line on the semilog graph paper. There are several exceptions to this simple rule of thumb, so it should be considered a minimum criterion.

E. Decontaminate the transducer(s) and cable(s) as specified in the Sampling Plan and SOP 1.6, General Equipment Decontamination.

3.3. Operation

A. The procedure to conduct pumping tests includes monitoring the water level over time in the pumping well and each observation well while the pumping well is discharged at a constant rate.

B. When the pumping test is performed using an electronic data logger and pressure transducer, store all data internally or on computer diskettes or tape. Directly transfer the information to the main computer and analyze it. Maintain a computer printout of the data in the files for documentation. Take manually determined measurements periodically to verify data recorded by the data logger.

C. If an electronic data logger and pressure transducer are not used, record all data on the Pump/Recovery Test Data form (Appendix 5.2). Data collected manually during a logger-transducer pumping test will also be recorded on the form. Fill out the form as described in Appendix 5.3.

D. During a pumping test, measure water levels as often as necessary to produce a meaningful indication of hydraulic properties of the aquifer. Measure water levels as specified in SOP 3.1, Water Level Measurement.

During the early part of the test, station at least one person at each observation well and at the pumping well. After the first two hours, two people are usually needed to continue the test. It is not necessary for readings at the wells to be taken simultaneously. It is very important that depth-to-water readings are measured accurately and recorded at the exact time they are measured.

NOTE: Pressure transducers and electronic data loggers may be used to reduce the field personnel hours required for the pumping test.

E. After pumping is concluded, measure recovering water levels to verify the results obtained from the pumping portion of the test. Measure the recovering water levels in the pumping well and the observation wells for a period immediately following the cessation of pumping. Monitoring during recovery should occur for at least half the length of the pumping portion of the aquifer test. The decision to cease monitoring water levels will be based on aquifer recovery.

3.4. Postoperation

3.4.1. Field

A. If using an electronic data logger, follow the steps listed below.

1. Stop the logging sequence.

2. Print the data or send it to the computer by telephone.

3. Save memory and disconnect the battery at the end of the day's activities.

B. Put the testing equipment in storage containers.

C. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

D. Restore the site to pretesting conditions as specified in the FSP or WP.

E. Make sure all wells are properly labeled and the location ID is readily visible on the guard pipe.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Interpret the pumping test results with the project hydrogeologist or site manager. Analyze data using appropriate analytical solution(s).

D. If necessary, send data logger or pressure transducers to the factory for recalibration.

4. SOURCES

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Freeze, R. Allen, and John A. Cherry. 1979. Groundwater. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Pump/Recovery Test Data Form

5.3. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

Water level measuring device:

_____ Water pressure transducer

_____ Electric water level indicator

_____ Weighted tapes with plopper

_____ Steel tape (subdivided into tenths of feet)

_____ Electronic data logger (if transducer method is used)

_____ Tape measure (subdivided into hundredths of feet)

_____ Watch or stopwatch with second hand

_____ Semilog graph paper (if required)

_____ Waterproof ink pen

_____ Thermometer

_____ Appropriate references and calculator

_____ Barometer or recording barograph (for tests conducted in confined aquifers)

APPENDIX 5.2

PUMP/RECOVERY TEST DATA FORM

PUMP/RECOVERY TEST DATA PAGE : OF ____

FACILITY CODE _____ **DISTANCE FROM PUMPED WELL (FT)** _____

LOCATION ID _____ **LOGGER CODE** _____

LOG DATE _____ **ACCEPTANCE CODE** _____

TEST START:
DATE _____
TIME _____
STATIC WATER LEVEL (FT) _____

TEST END:
DATE _____
TIME _____
WATER LEVEL (FT) _____

AVERAGE PUMPING RATE (GAL/MIN) _____

MEASUREMENT METHODS _____

COMMENTS _____

PUMP TEST			RECOVERY TEST	
ELAPSED TIME (MIN)	**DEPTH TO WATER (FT)**	PUMPING RATE (GAL/MIN)	**ELAPSED TIME (MIN)**	**DEPTH TO WATER (FT)**
0.00			0.00	

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

FTD–011 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PUMP/RECOVERY TEST DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

3. Log Date. The date when the measurement was made in the format DD-MMM-YY (01-JAN-88).

4. Distance From Pumped Well (Ft). Distance the observation well is from the pumping well in feet and tenths of feet.

5. Logger Code. Three-character code identifying the company responsible for performing field measurements or collecting samples.

6. Acceptance Code. One-character code assigned by the installation manager, but entered on the form by field personnel.

7. Test Start Date. The date when pumping was initiated in the format DD-MMM-YY (01-JAN-88).

8. Test Start Time. The time when pumping was initiated using the 24-hr clock with the format of hours:minutes (08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.).

9. Static Water Level (Ft). Depth-to-water in feet and hundredths of feet in the observation well at the beginning of the pumping test.

10. Test End Date. The date when pumping ceased.

11. Test End Time. The time when pumping ceased.

12. Water Level (Ft). Depth-to-water in feet and hundredths of feet in the observation well at the end of the pumping test.

13. Average Pumping Rate (Gal/Min). Total volume pumped (from totalizer meter) divided by the total elapsed time.

14. Measurement Methods. Type of instrument used to measure depth-to-water (may include steel tape, electric sounding probes, Stevens recorders, or pressure transducers).

15. Comments. Any additional information.

PUMP TEST:

a. Elapsed Time (Min.). Time of measurement recorded continuously from time 0.00 (start of test) in minutes.

b. Depth-to-Water (Ft). Depth-to-water in feet and hundredths of feet in the pump or observation well at the time of the water level measurement.

c. Pumping Rate (Gal/Min). Flow rate in gallons per minute of pumping measured from the in-line flow meter. This column should be completed only for the form used with the pumped well.

RECOVERY TEST:

a. Elapsed Time (Min). See above PUMP TEST a.

b. Depth-to-Water (Ft). See above PUMP TEST b.

STANDARD OPERATING PROCEDURE 4.1

SOIL BORING

1. PURPOSE

To ensure acceptable, consistent soil-boring procedures for all pertinent aspects of hazardous waste investigations.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of the soil-boring operation, including specifications for drilling techniques. Refer to the FSP or WP for the type, number, and depth intervals at which samples will be collected. Collection and measurement of samples and the documentation of data will be performed as specified in the associated procedures.

To the extent possible, the boring process should not alter the medium that is being investigated. Various methods can be used for soil boring. These include, but are not limited to, hollow-stem augering, cable tool, mud rotary, and air rotary. For most investigations, dry hollow-stem augering or cable tool are the preferred drilling methods. Additional information concerning boring techniques is contained in the SOP 4.2, Rock Boring.

When drilling is performed in areas in which suspected subsurface-source contaminants may be encountered in the vadose zone, special protocols may be implemented to prevent communication of these contaminants with underlying soil or groundwater. Information regarding the potential for these conditions will be specified in the appropriate FSP or WP. Specific procedures are contained in an Addendum to Mound Plant ER Program SOP 4.1. The Addendum is titled, Methods to Control Communication of Subsurface Contaminants with Groundwater.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation

1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
4.2	Rock Boring
4.3	Monitoring Well Installation
5.1	Soil and Rock Borehole Logging and Sampling
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. If samples are to be collected for analyses, notify the laboratory of sample types, the number of samples, and the approximate arrival date. In addition, contact the carrier that will transport samples to obtain information on regulations and specifications.

F. Ensure that boring or well-drilling permits required by state or local authorities have been obtained, as well as procedures for compliance with state or local regulations regarding the submission of well logs and samples.

G. Research the site hydrogeology to estimate the key parameters (for example, anticipate the aquifer depth and thickness and types of contaminants).

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Before drilling, decontaminate all downhole drilling and sampling equipment, as well as the back of the drilling rig (as described in SOP 1.6, General Equipment Decontamination).

B. Clear the work site of all brush and minor obstructions.

C. Stake the location of utilities and the proposed boring areas.

NOTE: Ensure that proposed boring areas are not traversed by utility transmission ways.

D. If drilling fluid or grout is required, the source(s) of any water to be used in grouting and well installation must be approved by the site manager before field operations.

3.3. Operation

A. Decontaminate sampling equipment between sampling events (as described in SOP 1.6, General Equipment Decontamination).

B. Inventory all samples as specified in SOP 1.3, Sample Control and Documentation.

C. Handle all samples as specified in SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

D. Soil sampling and borehole logging must conform to SOP 5.1, Soil and Rock Borehole Logging and Sampling.

E. If field screening of samples for organic vapors is required, conduct the survey as described in SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector, and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector.

F. If the boring is to be completed as a monitoring well, review SOP 4.3, Monitoring Well Installation, for pertinent information.

G. Ensure that the back of the drilling rig is free of any leaking hydraulic lines. Do not grease surfaces to the point that excess grease could be dislodged during drilling.

H. Conduct work in compliance with all Occupational Safety and Health Administration (OSHA) regulations regarding drilling safety and the detection of underground utilities. If required by safety considerations, staked boring should be moved.

I. For each operating drill rig, designate an individual to be responsible for logging the samples, preparing the boring logs and well sketches, and the well installation

of that rig. More than one rig at a time may be supervised by a qualified individual.

J. Log the samples, prepare the boring logs and well sketches, and supervise the well installation.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

K. Do not use dyes, tracers, or other substances or introduce them into borings, wells, lysimeters, grout, backfill, groundwater, or surface water unless specifically required by the contract.

L. If drilling fluids are required, maintain portable recirculation tanks for accurate records of fluid loss.

M. If specified, air systems include an air line oil filter that requires frequent replacement to remove all oil residue from the air compressor. Describe the air system manufacturer's name, model number, air pressures used, the frequency of changing the air line oil filter, and the evaluation of air line filtering in the logbook.

N. Follow the sampling interval and type of sampling equipment specified in the FSP or WP unless directed by the site manager.

O. Record all field measurements and comments on the Borehole Log (Soil) form (see SOP 5.1). Complete all lines on the forms. Use the letter designation NA for not applicable, ND for not done, or UNK for unknown when applicable. If some steps or procedures are not performed as described, state the reason (as is practicable) on the Borehole Log (Soil) form or submit it as an attachment.

P. Maintain a daily detailed driller's report during drilling. Resolve all disputes concerning drilling time, standby time, and work progress at the end of each day. The driller's representative should sign and initial the daily report to indicate concurrence. The report should provide a complete description of all formations encountered, the number of feet drilled, the number of hours on the job, any shutdowns because of breakdown, the feet of casing set, and other pertinent data.

Q. Collect, containerize, and store all excess soil cuttings, waste materials, and decontamination solutions for proper disposal as specified in the FSP or WP.

R. If temporary casing is specified in the FSP or WP, advance the casing to the specified depth. Remove all loose material within the casing before sampling. Advance the casing according to project requirements. Use the type of casing-advance technique that is specified in the FSP or WP. The casing will be of the flush-joint or flush-couple type and of sufficient size to allow for soil sampling, coring, or well installation. All casing sections should be straight and free of any obstructions. If hollow-stem augers are used, equip the bit with a plug device that can be removed at the required sampling depth.

S. The abandonment of any boring should follow any appropriate state regulations and be approved before any casing removal or sealing/backfilling. Seal borings by grouting from the bottom of the boring or well to the ground surface. This can be accomplished by placing a tremie pipe at the bottom of the boring and pumping grout through this pipe until undiluted grout flows from the boring at ground surface. The grout or tremie pipe may be gradually withdrawn, as long as the end of the pipe is at least 10 ft below the grout surface. The grout should consist of a neat cement with 4 lbs of commercial bentonite and approximately 7.5 gallons of water added for every 94-lb bag of cement. After the grout has set (about 72 hrs), the contractor should check the abandoned site for grout settlement. Fill any depression in the grout with the grout mix described above. Methods other than those described here may be implemented as dictated by appropriate state or local agencies. Do not use any grout additives except the 4% bentonite.

T. Safety equipment should be specified by the site health and safety officer. In all cases, the minimum physical protection worn by drilling personnel should include a hard hat, safety glasses, gloves, steel-toed leather boots, and hearing protection.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all borehole locations are properly staked and the location ID is readily visible on the location stake.

D. Have the driller approve and initial the report of progress at the end of each operating day.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

D. If required by local or state law, file well-installation reports.

E. After a land survey, verify that the drilling permit describes the site location accurately. If necessary, modify and resubmit the permit.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. If samples have been collected for analysis, contact the laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

D. If drilling wastes were stored, determine the appropriate disposal (based on laboratory analysis) of the soils from the borings.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representaive Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Sample containers

_____ Appropriate clothing

_____ Sprayer with clean water for dust control

_____ Any applicable licenses and permits

_____ Camera and film

_____ Measuring tape

_____ Plastic sheets

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 4.1.1

ADDENDUM TO STANDARD OPERATING PROCEDURE 4.1

METHODS TO CONTROL COMMUNICATION OF SUBSURFACE CONTAMINANTS WITH GROUNDWATER

1. PURPOSE

To insure that acceptable, consistent soil-boring procedures are used to prevent communication of subsurface contaminants in vadose zone soils or landfill materials with underlying groundwater.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of the soil-boring operation at a given site, including specifications for drilling techniques. This Standard Operating Procedures (SOP) serves as an Addendum to SOP 4.1 when drilling is performed in areas in which suspected subsurface contaminants may be encountered in vadose zone soils or landfill materials. This Addendum outlines special protocols that should be implemented to prevent communication of these contaminants with underlying groundwater.

3. PROCEDURES

Consult SOP 4.1 for information regarding associated procedures, preparations, and postoperations for soil boring activities. The following procedures will be implemented when high concentrations of contaminants are encountered during drilling in vadose zone soils or landfill materials.

A. Use hollow stem auger drilling techniques and collect continuous core.

B. Monitor core for volatile vapors using a photoionization detector and an organic vapor analyzer.

C. When drilling through landfilled materials, examine core for artificial-fill/native-soils contact.

D. Identify the depth of the soil contamination or the depth of the base of the landfill.

E. Determine the relation of the soil contamination or the base of the landfill to the anticipated depth of static water table.

F. Remove augers and enlarge the borehole to 1 ft below base of the contamination or landfill.

G. Set surface casing from bottom of borehole to ground surface and pressure grout the annulus between outside of surface casing and borehole wall.

H. Allow 24 hrs for grout to harden.

I. Resume drilling at base of borehole with hollow-stem augers and collect continuous core to the prescribed depth of the borehole.

STANDARD OPERATING PROCEDURE 4.2

ROCK BORING

1. PURPOSE

To ensure acceptable, consistent rock boring procedures for all pertinent aspects of hazardous waste investigations.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of the rock-boring operation, including specifications on drilling techniques to be used at a site. Refer to the FSP or WP for the type, number, and depth intervals at which samples will be collected. Collection and measurement of samples and the documentation of data will be performed as specified in the associated procedures.

Rock boring provides samples for logging, geotechnical analysis, and monitoring well installation. The boring process should not (to the extent practicable) alter the medium that is being investigated. Rock-boring techniques include, but are not limited to, cable tool, rotary, reverse-circulation rotary, and coring.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
4.3	Monitoring Well Installation
5.1	Soil and Rock Borehole Logging and Sampling

6.1 Health and Safety Monitoring of Combustible Gas Levels

6.2 Health and Safety Monitoring of Organic Vapors with a Photoionization Detector

6.3 Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. If samples are to be collected for analyses, notify the laboratory of sample types, the number of samples, and the approximate arrival date. In addition, contact the carrier that will transport samples to obtain information on regulations and specifications.

F. Obtain all boring or well-drilling permits required by state or local authorities and informtion required for compliance with state or local regulations regarding the submission of well logs and samples. Obtain utility maps for the site and coordinate boring locations with utility companies.

G. Research the site hydrogeology to estimate the key parameters (for example, anticipated aquifer depth and thickness, types of contaminants, and grain-size distribution).

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Before drilling, decontaminate all downhole drilling and sampling equipment, as well as the back of the drilling rig (as described in SOP 1.6, General Equipment Decontamination).

B. Clear the working areas of brush and minor obstructions.

C. Stake the location of utilities and locations for proposed borings.

NOTE: Ensure that proposed boring areas are not traversed by utility transmission ways.

D. If drilling fluid or grout is required, the source(s) of any water to be used in grouting and well installation must be approved by the site manager before field operations.

3.3. Operation

A. Decontaminate sampling equipment between sampling events as described in the SOP 1.6, General Equipment Decontamination.

B. Handle all samples as described in the SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

C. Rock sampling and borehole logging must conform to the specifications defined in the SOP 5.1, Soil and Rock Borehole Logging and Sampling.

D. If field screening of samples for organic vapors is required, conduct it as described in the SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector, and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector.

E. If the boring is to be completed as a monitoring well, review the SOP 4.3, Monitoring Well Installation, for pertinent information.

F. The back of the drilling rig must be free of any leaking hydraulic lines. Do not grease surfaces to the point that excess grease could be dislodged during drilling.

G. Conduct work in compliance with Occupational Safety and Health Administration (OSHA) regulations regarding drilling safety and the detection of underground utilities. If required by safety considerations, relocate the borings.

H. For each operating drill rig, designate an individual to be responsible for logging samples, preparing boring logs and well sketches, and the well installation of that rig. More than one rig at a time may be supervised by a qualified individual.

I. Do not use dyes, tracers, or other substances or introduce them into borings, wells, soil moisture (water) samplers, grout, backfill, groundwater, or surface water unless specifically required by the contract.

J. If drilling fluids are required, do not use dug (lined) sumps; portable recirculation tanks are required.

K. Log the samples, prepare the boring logs and well sketches, and supervise the well installation.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

L. If specified, air systems should include an air line oil filter that requires frequent replacement to remove all oil residue from the air compressor. The use of any air system should be fully described in the driller's log and include an equipment description, the manufacturer's name, model name, air pressures used, the frequency of changing the air line oil filter, and an evaluation of the air line filtering.

M. Follow the sampling interval and type of sampling equipment specified in the FSP or WP unless directed by the site manager.

N. Record all field measurements and comments on the Borehole Log (Rock) form (see SOP 5.1). Complete all lines on the forms. Use the letter designation NA for not applicable, ND for not done, or UNK for unknown when applicable. If some steps or procedures were not performed as described, state the reason (as practicable) on the Borehole Log (Rock) or submit it as an attachment.

O. During drilling, maintain a daily detailed driller's report and have a qualified person submit it if requested by the site manager. The report will provide a complete description of all formations encountered, the number of feet drilled, the number of hours on the job, any shutdowns because of breakdown, the feet of casing set, and other pertinent data.

P. If rock coring is specified, follow the procedure described below.

1. Casing is required for the full depth of the overburden in borings when rock is cored.

2. Advance the casing according to specifications in the FSP or WP. The casing should be of the flush-joint or flush-couple type and of sufficient size to allow for soil sampling, coring, and well installation. All casing sections should be straight and free of any obstructions. If hollow-stem augers are to be used, equip the bit with a plug device that can be removed at the required sampling depth.

3. Use drill rods for drilling rock that are NW in size to minimize vibration and chattering. Rock core size should be NX, NQ (wire line), or a size specified in the FSP or WP.

4. Use core barrels of the improved double-tube varieties (like the Christensen Series C or D models or the equivalent) that are equipped with a split inner tube.

5. Use five-ft barrels at the discretion of the site manager.

6. Make every effort to use clear water as a drilling fluid. In the event that this is impractical, recirculated water may be used at the discretion of the site manager, as long as a settling tank and filtering system are provided.

7. To minimize core losses in soft, erodable rock, the measures listed below should be required by the supervising field technician.

   a. Restrict drilling to short runs of 2 to 3 ft.

   b. Keep drilling water pressure low (under 150 psi).

   c. Keep feed pressure under 100 psi.

8. The supervising geologist should not permit a full coring run to be drilled if he/she suspects that core was left in the hole on the previous run. If this is believed to have occurred, shorten the next coring run by the length of core believed to have been left in the hole. This is necessary to prevent blocking the core barrel and grinding the core.

9. Upon removal of the core barrel from the drill hole, the driller should remove and open the split inner tube and deliver it to the field technician. If necessary to facilitate accurate logging, wipe off the core while it rests in the inner half.

10. Store rock cores in cardboard or wood core boxes so that their relative position by depth is preserved. Note intervals of lost core in the core sequence. Clearly mark the top of the core sequence. Mark boxes with the boring number, cored interval, and box number in cases of multiple boxes. The weight of each fully loaded box should not exceed 75 lbs. No data should appear on or within the box that is not specified on the Boring Log (Rock).

11. Each box should contain core from only one borehole. If spacers are required to separate intervals of core runs, use wooden blocks that have been clearly marked with the missing interval of core.

Q. If tri-cone rotary drilling is used, record the items below.

1. Rate of drilling

2. Percent of drilling fluid recovery

3. Changes in drilling fluid and water color

4. Lithologic description

   Determine lithologies by using a kitchen screen to separate rock particles from the return waters. Describe the cuttings according to SOP 5.1, Soil and Rock Borehole Logging and Sampling. Place the

cuttings on plastic sheets for easier tracking of depth and examination.

R. In the abandonment of any boring, follow any appropriate state regulations and obtain approval before any casing removal or sealing/backfilling. Seal borings by grouting from the bottom of the boring or well to the ground surface. This will be accomplished by placing a tremie pipe at the bottom of the boring and pumping grout through this pipe until undiluted grout flows from the boring at the ground surface. The grout or tremie pipe may be gradually withdrawn, as long as the end of the pipe is at least 10 ft below the grout surface. The grout should consist of a neat cement with 4 lbs of commercial bentonite and approximately 7.5 gallons of water added for every 94-lb bag of cement. After the grout has set (about 72 hrs), the contractor should check the abandoned site for grout settlement. Fill any depression in the grout with the grout mix described above. Methods other than those described here may be implemented as dictated by appropriate state or local agencies. Do not use any grout additives except the 4% bentonite.

S. Safety equipment should be specified by the site and safety officer. In all cases, the minimum physical protection worn by drilling personnel should include a hard hat, safety glasses, gloves, steel-toed boots, and hearing protection.

3.4 . Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions as specified in the FSP or WP.

C. Make sure all borehole locations are properly staked and the location ID is readily visible on the location stake or protective casing.

D. Have the driller approve and initial the report of progress at the end of each operating day.

E. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

D. If required by local or state law, file well-installation reports.

E. After a land survey, verify that the drilling permit describes the site location accurately. If necessary, modify and resubmit the permit.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. If samples have been collected for analysis, contact the laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

D. If drilling wastes were stored, determine the appropriate disposal (based on laboratory analysis) of the soils from the borings.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representaive Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1.

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Sprayer with clean (potable) water for dust control

_____ Core boxes

_____ Wood block or lath

_____ Measuring tape (tenths)

_____ Large, black permanent marker

_____ Strapping tape

_____ Appropriate clothing

_____ Sprayer with clean water for dust control

_____ Any applicable licenses and permits

_____ Camera and film

_____ Sample containers

_____ Plastic sheets

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 4.3

MONITORING WELL INSTALLATION

1. PURPOSE

To ensure acceptable, consistent monitoring well installation.

2. DISCUSSION

Monitoring well installation creates a permanent access for collecting groundwater samples and measuring aquifer characteristics. Ideally, the well should not alter the medium that is being sampled.

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of monitoring well installation at a given site. A list of critical issues involved in monitoring well installation are listed below.

- Soil/rock boring technique
- Casing and screen materials
- Casing and screen diameter, screen length and size, and screened interval
- Filter pack, annular seal, grout, protective cap, and protective casing

Monitoring wells with a minimum borehole diameter of 8 inches will be installed using appropriate drilling techniques. All well construction materials should be chemically inert and also of sufficient strength to provide long-term structural integrity during well development and use. Therefore, it is recommended that four-inch-diameter, stainless steel, 0.010-inch slot well screen (or as specified in the work plan) be coupled with 4-inch-diameter, Schedule 40 PVC or stainless steel riser pipe as specified in the work plan. The location and completion depth of each well will be outlined in the applicable work plan or field sampling plan. A 10-ft long well screen is recommended for most monitoring well installations. In rare cases, well screens greater or less than 10 ft in length can be installed based on field conditions or as specified in the work plan. A quartz sand filter pack as specified in the work plan will stem the annulus between the well string and the borehole wall from the bottom of the borehole to no more than 2 ft above the top of the well screen. Grain size of the geologic medium will be evaluated by the onsite geologist to confirm that the proper filter pack size is used. It is recommended that the filter pack be emplaced as a sand slurry (composed of silica sand and project-approved potable water) using a tremie pipe. This procedure will help the sand to settle and compact within the borehole annulus and prevent the sand from bridging along the well screen interval. During emplacement, the depth to the top of the filter pack will be frequently tagged using a weighted measuring tape. A 2- to 4-ft interval of bentonite pellets or slurry will be emplaced on top of the filter pack using a tremie pipe. The bentonite will adequately seal the zone of completion. The remaining borehole annulus will be stemmed to the ground surface using a cement/bentonite grout mixture.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Borehole drilling, development of the wells, collection and measurement of samples, and the documentation of data will be performed as described in the associated procedures. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement
4.1	Soil Boring
4.2	Rock Boring
4.4	Monitoring Well Development
5.1	Soil and Rock Borehole Logging and Sampling
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Research site hydrogeology to estimate key parameters (for example, anticipated aquifer depth and thickness, types of contaminants, and grain-size distribution).

E. If water/sand slurry or grout is required, the source(s) of any water used must be approved by the site manager before field operations.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record all pertinent information (date, site, ID #, and location) in the logbook or on the appropriate form. Include field conditions, unusual circumstances, and weather. Instructions for logbook entries are in SOP 1.3, Sample Control and Documentation.

3.2.3. **Field**

A. Decontaminate all equipment before monitoring well installation, as specified in SOP 1.6, General Equipment Decontamination.

3.3. Operation

A. Monitoring wells must be installed in such a manner as to minimize disturbance and prevent introduction of contaminants to the subsurface environment. This is especially important if rotary drilling techniques using circulation fluid are employed. Any use of solvents, glues, soap, or cleaners is prohibited below grade unless otherwise stated in the specifications. When they are used, describe the material and include the manufacturer and type (specification). The use of pipe dope, grease, and oil is also prohibited; however, the use of teflon pipe dope is acceptable.

B. Monitor downhole and the breathing zone according to SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector. Perform readings as often as necessary to ensure the safety of workers. Record all measurements on the data collection forms included with these SOPs.

C. Record all field measurements and comments on the Well Completion Information or the Borehole/Well Construction Field Data Log form. Complete all lines on the forms. Use the letter designation NA for not applicable, ND for not done, or UNK for unknown when applicable. If some steps or procedures were not performed as described, state the reason (as practicable) on the form or submit it as an attachment. Copies of these forms are in Appendix 5.1 and Appendix 5.2, respectively. Fill out the forms as described in Appendix 5.6. For a current list of codes used in the data form completion, consult the ER Program data administrator.

D. Record the diagram of the well installation on the Well Completion Information form and show the depth from surface grade, the bottom of the boring, sump, screen location, coupling design and location, granular backfill, seals, grout, cave-in, centralizers, and the height of the riser above the ground surface. Record the actual composition of the grout, seals, and granular backfill on each Borehole/Well Construction Field Data Log form. Include the screen slot size (in inches), slot configuration, and screen manufacturer.

E. If appropriate, include the protective casing detail on all well sketches.

F. If a quartz sand filter pack is specified, follow the instructions listed below.

   1. Base the average grain size of the sand on the expected grain-size distributions in the screened formation and the size of predesigned well-screened openings. Use sand having a gradation that will allow no more than 10% of pack material to pass through the screen slots.

   2. Take at least one sample (1/2 to 1 pint in size) from each shipment of granular material, assign an identification number, and store it with the soil samples. Record the identification number on the sketch of each installation for which that material was used.

   3. The specifications of the proposed sand-pack material should be submitted by the contractor for approval before use. Describe each sample in terms of lithology, grain-size distribution, and source (company from which it was purchased and the pit or quarry of origin). This material should be clean, inert, and siliceous. Use well-sorted (poorly graded) sand, like No. 8-12 or a similar material, with approximately 10% passing the design slot size.

G. It is desirable that all padlocks at a given site can be opened by the same key. The numbers on the locks should be noted and then rubbed off the back.

H. Safety equipment should be specified by the site health and safety officer. In all cases, the minimum physical protection should include a hard hat, safety glasses, gloves, steel-toed leather boots, hearing protection, and coveralls for splash protection and cold weather.

I. Typical well construction features are in Appendixes 5.3 and 5.4. However, specific contract requirements may alter some of the components or values. After well development (SOP 4.4) is complete, indicate the water level on the well construction diagram of the Well Completion Information Form (Appendix 5.1).

J. When applicable, use stainless steel centralizers to assure the uniform and complete annular filling by granular backfill, seal, and grout materials. Fasten centralizers to the well casing by mechanical fasteners and radially space them around the casing at 120° or 90° intervals. On the Borehole/Well Construction Field Data Log form (Appendix 5.2), provide a description of the fastening device and centralizer that includes their locations.

K. If specified, place a quartz sand filter pack in the annulus next to the well screen in all monitoring wells. The sand pack ensures continuous flow capability from the natural formation to the well bore.

1. Fill the annulus between the well screen and borehole wall with a sand slurry (composed of silicon sand and project-approved potable water) using a tremie pipe. Frequently tag the depth to the top of the filter pack using a weighted measuring tape during this process to insure proper placement.

2. It is necessary to emplace sufficient sand slurry to stem the annular interval between the bottom of the borehole to no more than 2 ft above the top of the well screen after the sand pack has compacted and settled.

3. Ascertain the depth of the top of the sand with an acceptable measuring device or the tremie pipe and verify the thickness of the sand pack. If necessary, add more sand to bring the top of the sand pack to the proper elevation (no more than 2 ft above the top of the screen).

4. Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without the threat of cross flow between producing zones.

5. The site manager is the only individual authorized to modify an existing well design.

6. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during sand pack placement to the extent practical. Remove them as the level of the sand pack rises above the bottom of the augers.

L. Place a bentonite seal between the sand pack and grout to prevent infiltration of cement into the filter pack and the well. In special circumstances, an open borehole may be drilled to a depth below where the screen is set. If grout is used to seal off a lower aquifer or as backfill up to the proper level, place a bentonite seal above the grout before the casing, screen, and sand pack are introduced. Allow the grout to set up for a minimum of 12 to 24 hrs before placing the seal. Place the bentonite seal in the monitoring well as described below.

1. Fill the annulus between the well casing and borehole with a bentonite seal at least 2- to 4-ft thick (vertically) above the filter pack.

2. For wells less than approximately 50 ft in depth, use bentonite pellets. The pellets should have a minimum purity of 90% montmorillonite clay and a minimum dry bulk density of 75 lb/ft^3 for 1/2-inch pellets (as provided by American Colloid) or the equivalent. Pour the bentonite pellets directly down the annulus. Avoid introducing pellets into the well bore. Place a cap over the top of the well casing before pouring the bentonite pellets from the bucket. Pour the pellets

from different points around the casing to ensure even application. A tremie pipe may be used to redistribute and level out the top of the seal.

3. For the wells deeper than approximately 50 ft, the bentonite seal may either be poured as pellets or introduced as a slurry. The method should be determined by the site manager after evaluating the condition of the well and borehole wall. If there are no centralizers in the upper portions of the casing, manipulate the casing to prevent pellets from hanging up in the narrow annulus and to allow them to settle to the bottom as rapidly as possible.

4. If a slurry of bentonite is used as annular seal, prepare the slurry by mixing powdered or granular bentonite with potable water. The slurry should be of sufficiently high specific gravity and viscosity to prevent its displacement by the grout that will be placed above. Regardless of depth and depending on fluid viscosity, a few handfuls of bentonite pellets may be dumped in to solidify the surface of the bentonite slurry as a precaution.

5. Before adding bentonite pellets or slurry, be sure the sand pack has ceased settling by measuring the depth of the top of the sand with the tremie pipe. The sand pack should provide an adequate cover over the screen.

6. If a bentonite slurry is used, visually check the condition of the slurry by pumping into a bucket or onto the ground. Retract the tremie pipe 3 ft from the top of the sand pack and begin pumping.

7. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during bentonite seal placement to the extent practical. Remove them as the level of the bentonite rises above the bottom of the augers.

8. In all situations, use a 2 to 4-ft bentonite seal. Tag the top of the seal by an acceptable measuring device or tremie pipe to verify that the proper thickness of seal has been placed in the annulus.

9. Until the specified quantity of bentonite has been placed in the well annulus, repeat the application and verification.

M. Place grout from the top of the bentonite seal to the surface and allow a minimum of 24 to 48 hrs after the bentonite seal has been placed to allow it to set up. Only Type I or Type II cement without accelerator additives may be used. Place grout in the monitoring wells as described below.

1. Fill the annulus between the well casing and borehole wall with grout.

2. Place the grout from a grout tremie pipe.

3. The tremie pipe should normally consist of 1.25-inch PVC or steel pipe. One-inch rolled, thin-walled polypipe has been used with success in some cases.

4. Pump the grout through this pipe to the bottom of the open annulus until undiluted grout flows from the annulus at the ground surface.

5. The grout should consist of a neat cement mix composed of 4 lbs of commercial bentonite and approximately 7.5 gallons of water added to each 94-lb bag of cement. Use only grout mixed with approved water.

6. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during grouting to the extent practical. Remove them as the level of the grout rises above the bottom of the augers.

7. While the grout is still green, add more grout to compensate for the removed casing or auger and tremie pipe and to ensure that the top of the grout is at or above the ground surface.

8. The protective casing should now be placed.

9. After the grout has set (about 48 hrs), fill any depression in the grout caused by settlement with a grout mix similar to that described above.

N. Install protective casing around all monitoring wells. Exceptions may be made on a case-by-case basis. The minimum elements in the protection design include those listed below.

1. The protective steel cap should keep precipitation out of the protective casing and should be secured to the casing by padlocks.

2. Set a 5-ft (minimum) length of black iron pipe or galvanized pipe so that the top of the pipe is about 1.5 to 3 ft above the ground surface and grout it in place as shown in Appendixes 5.3 and 5.4.

3. Use the pipe diameter of 8 inches for 4-inch wells and 6 inches for 2-inch wells (depending on approved borehole size). A drain hole near ground level that is 0.5 inch in diameter is permitted.

4. Provide a protective steel cap and secure it to the top of each protective casing.

5. Mark the location ID on the inside and outside of the cover with indelible ink and on the protective casing with paint.

O. Install a concrete well apron or pad around each monitoring well as shown in Appendix 5.5. The apron will be constructed with minimum radius of 3-ft (6- by 6-ft) and 4 inches thick. The body of the apron should contain a 4- by 4 inch wire mesh to reinforce the structure. The concrete surface should be roughened for traction and bevelled at an angle of 2 degrees to drain runoff. A 10-inch diameter sona tube should surround the protective casing with bentonite powder, filling the annulus between the casing and the tube. This will prevent the apron from cracking during periods of frost heave. A surveyor's pin stamped with the well location ID should be installed on the well apron surface before the concrete hardens.

P. The installation of guard posts around the periphery of the well apron is recommended in areas where vehicle traffic might pose a hazard.

Guard posts shown in Appendix 5.6 consist of steel posts that are 3 inches in diameter or tee-bar driven steel posts. Three are radially located 4 ft around each well and driven 2 ft below the ground surface, having a minimum of 4 ft above the ground surface with flagging in areas of high vegetation. Each post may be cemented in place.

Q. Drilling through a suspected zone of contamination within the vadose zone could create a more permeable conduit for infiltrating groundwater to enter and leach potential contaminants to the static water table. The following protocols are supplemental to information described in Section 3.3 for borehole drilling and installation of monitoring wells in this type of situation. Borehole and well construction details are shown in Appendix 5.7.

1. Use appropriate drilling techniques to collect continuous core.

2. Monitor core for volatile vapors as described in Section 3.3.B.

3. Examine core as described in SOP 5.1, Soil and Rock Borehole Logging and Sampling, to determine the vertical extent of contaminated soils.

4. Remove drill string and enlarge the borehole to 1 ft below the base of the zone of contamination.

5. Set surface casing from the bottom of the enlarged borehole to the ground surface and pressure grout the annulus between the outside of the surface casing and the borehole wall. Use Type I or Type II cement without accelerator additives. The grout should be mixed according to specifications outlined in Section 3.3.M.5.

6. Allow a minimum of 24 hours for the grout to set up.

7. Trip the drill string to the base of the surface casing and drill a telescoped borehole to the depth specified in the applicable work plan or field sampling plan.

8. Install the monitoring well according to specifications outlined in Section 3.3.

R. In the event that a borehole must be abandoned for failure to reach the specified depth (or any other cause), grout the borehole with a tremie pipe from the bottom up with grout mixed to the specifications described in Section 3.3.M.5.

S. In the event that a well must be abandoned for failure to reach specified depths, loss of tools, or inadvertent contamination, rip the screened interval with an appropriate tool. Grout the well with a tremie pipe (from the bottom up) with grout mixed to the specifications described in Section 3.3.M.5.

3.4 Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to predrilling conditions as specified in the FSP or WP.

C. Make sure all monitoring wells are properly labeled and the location ID is readily visible on the protective casing.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representative Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIXES

5.1. Well Completion Information Form

5.2. Borehole/Well Construction Field Data Log Form

5.3. Typical Construction of Overburden Well

5.4. Typical Construction of Bedrock Well

5.5. Typical Construction of Well Apron

5.6. Post Placement Around Well

5.7. Typical Construction of Telescoped Well with Surface Casing

5.8. Data Form Completion

APPENDIX 5.1

WELL COMPLETION INFORMATION FORM

WELL COMPLETION INFORMATION

PAGE 1 OF 2

FACILITY CODE _____

LOCATION ID _____

ACCEPTANCE CODE _____

OWNER CODE _____

INSTALLER CODE _____

INSTALLATION DATE _____

CASING ELEVATION (FT MSL) _____

CASING LENGTH (FT) _____

CASING DIAMETER (IN) _____

SEAL END DEPTH (FTFD) _____

SCREEN MATERIAL _____

RISER MATERIAL _____

FILTER PACK LENGTH (FT) _____

FORMATION OF COMPLETION (US/RC) _____

WELL TYPE CLASSIFICATION _____

WELL COMPLETION METHOD _____

ZONE OF COMPLETION _____

OPEN/SCREEN DEPTH (FTFD) _____

OPEN/SCREEN LENGTH (FT) _____

OPEN/SCREEN AREA (IN^2 /FT) _____

FLOW RELATIONSHIP _____

CAP MATERIAL _____

CAP TYPE _____

WELL TYPE CLASSIFICATIONS:
- M – MONITOR WELL
- P – PRODUCTION WELL
- T – TEST WELL
- O – OTHER (SPECIFY)

CAP TYPES:
- LC – LOCKING
- SL – SLIP–ON
- TR – THREADED
- NO – NONE
- SC – SCREW ON
- OT – OTHER (SPECIFY)

CASING, CAP, RISER MATERIALS :
- BR – BRICK
- CI – CONCRETE
- CU – COPPER
- FI – FIBERGLASS
- GI – GALVANIZED IRON
- WI – WROUGHT IRON
- SS – STAINLESS STEEL
- OM – OTHER METAL
- TE – TEFLON
- PV – PVC
- RS – ROCK OR STONE
- ST – STEEL
- TI – TILE
- CS – COATED STEEL
- WO – WOOD
- NO – NONE
- OT – OTHER (SPECIFY)

FLOW RELATIONSHIPS:
- U – UPGRADIENT
- D – DOWNGRADIENT
- C – CROSS GRADIENT
- O – ON SITE
- N – NOT KNOWN
- B – BACKGROUND

ZONES OF COMPLETION:
- A – ARTESIAN
- B – ANISOTROPIC
- C – CONFINED
- H – AQUITARD
- G – AQUICLUDE
- I – ISOTROPIC
- M – MULTI–SYSTEM
- S – SEMI–CONFINED
- U – UNCONSOLIDATED

WELL COMPLETION METHODS:
- C – POROUS CONCRETE
- F – GRAVEL PACK
- H – HORIZONTAL GALLEY
- O – OPEN END
- P – PERFORATED/SLOTTED
- S – SCREEN
- T – SAND POINT
- W – WALLED OR SHORED
- X – OPEN
- O – OTHER (SPECIFY)

NOTE : FTFD = FEET FROM DATUM

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WCD–005 (3/88)

FORM COMPLETED BY/DATE _____

TECHNICAL REVIEWER/DATE _____

APPENDIX 5.1, Continued

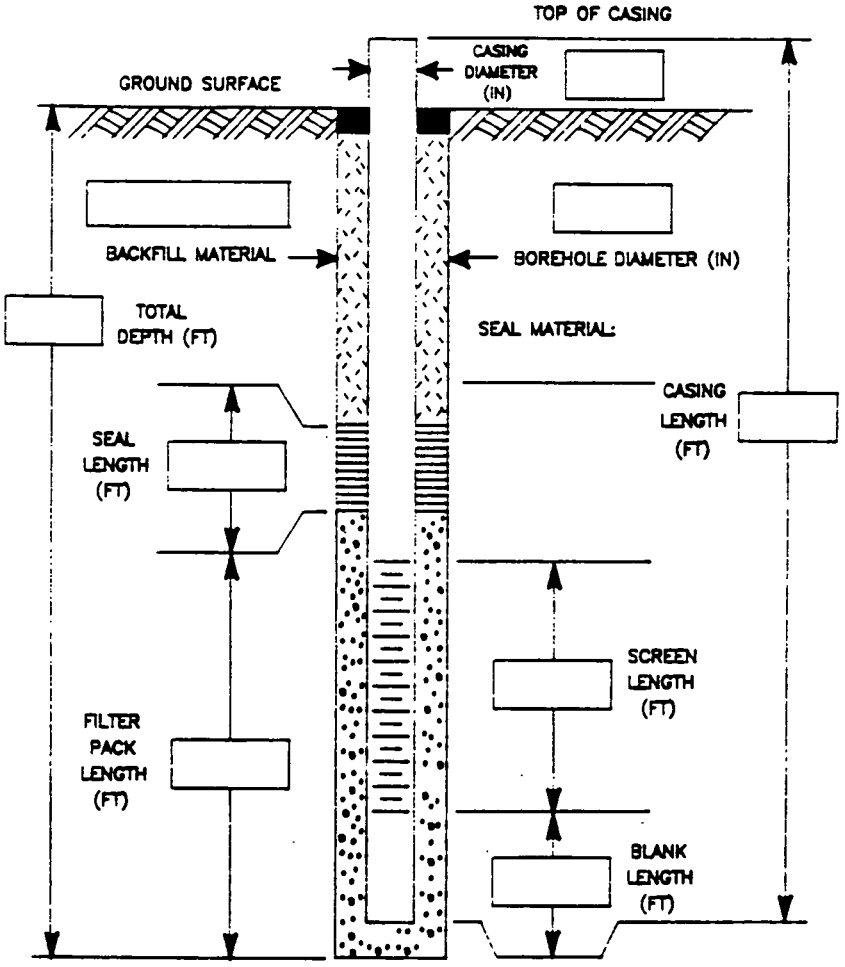
WELL COMPLETION INFORMATION FORM

WELL COMPLETION INFORMATION

PAGE 2 OF 2

FACILITY CODE _____

LOCATION ID _____ INSTALLATION DATE _____



FILTER PACK MATERIAL: _____

COMMENTS _____

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

WCD-005 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.2

BOREHOLE/WELL CONSTRUCTION FIELD DATA LOG

BOREHOLE / WELL CONSTRUCTION FIELD DATA LOG

FACILITY CODE _____ LOCATION ID _____ FIELD REP _____

LOGGER CODE _____ DRILLER CODE _____ RIG TYPE _____

INSTALLER CODE _____ COMPLETION DATE _____ ACCEPTANCE CODE _____

BOREHOLE SUMMARY

BIT TYPE	HOLE DIAM (in)	END ● DEPTH (ft)	FLUID TYPE

CASING SUMMARY

CASING* TYPE	DESCRIPTION	DIAM (in)	END ▲ DEPTH (ft)

● P – Protective S – Screen O – Open N – None

▲ Depth from Top of Casing

CONSTRUCTION TIME LOG

ACTIVITY	START DATE	START TIME	END TIME
DRILLING			
CASING			
FILTER PACK			
SEAL			
BACKFILL			
DEVELOPMENT			
OTHER			

WELL CONSTRUCTION

TYPE* CODE	DESCRIPTION	END ● DEPTH (ft)

* B – Backfill S – Seal F – Filter Pack

● Depth From Ground Surface

WELL DEVELOPMENT

COMMENTS _____

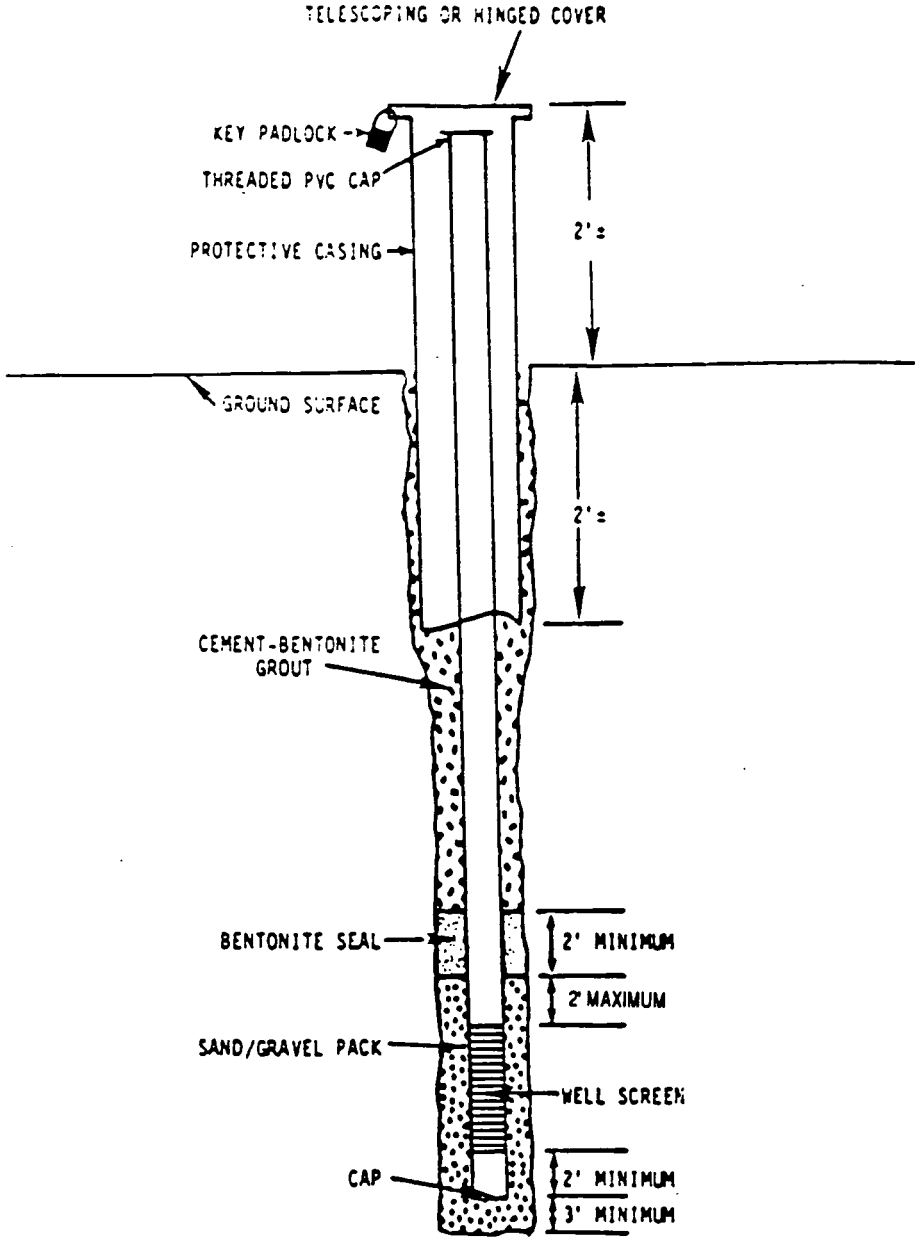
ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

BMC–044 (1/88) FORM COMPLETED BY/DATE TECHNICAL REVIEWER/DATE

APPENDIX 5.3

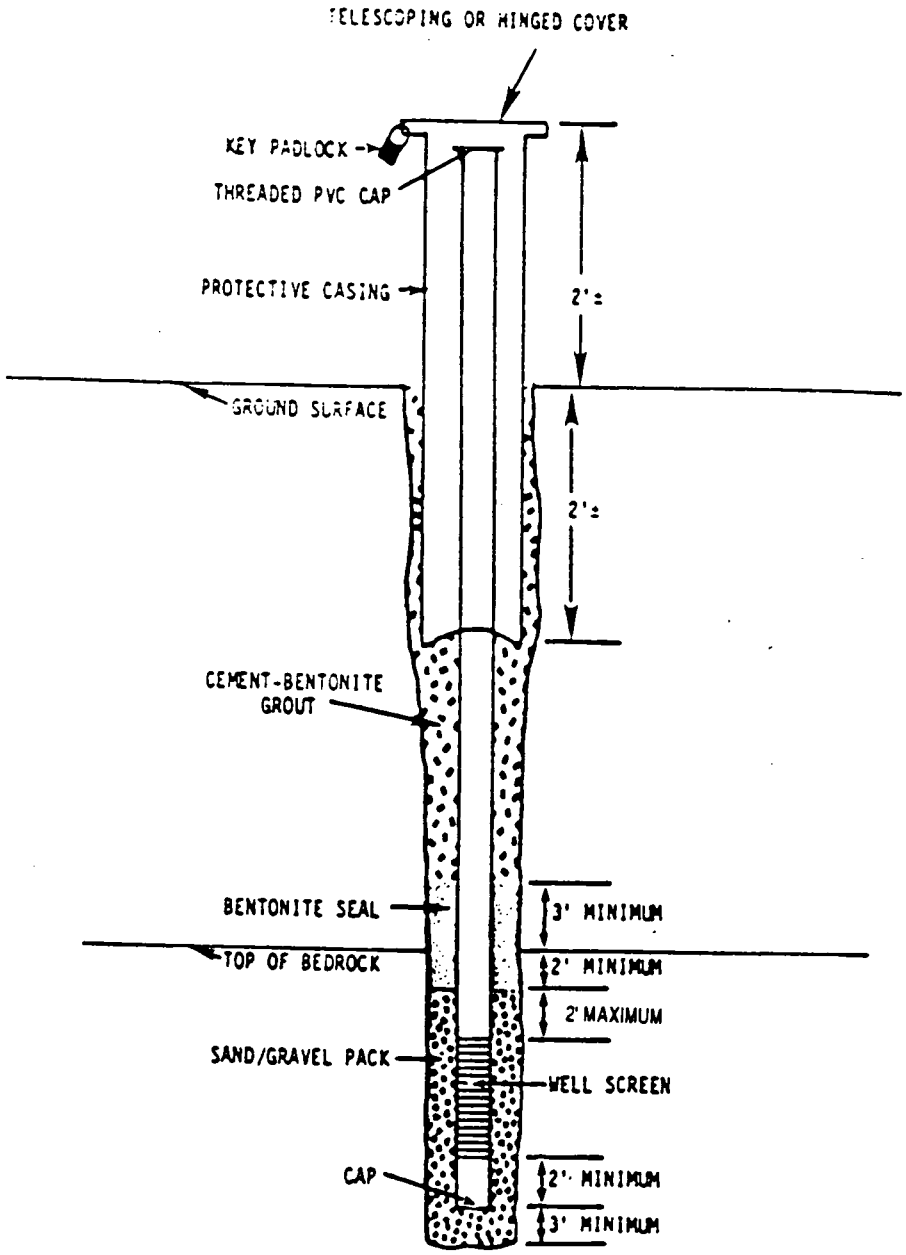
TYPICAL CONSTRUCTION OF OVERBURDEN WELL



TYPICAL CONSTRUCTION OF OVERBURDEN WELL

APPENDIX 5.4

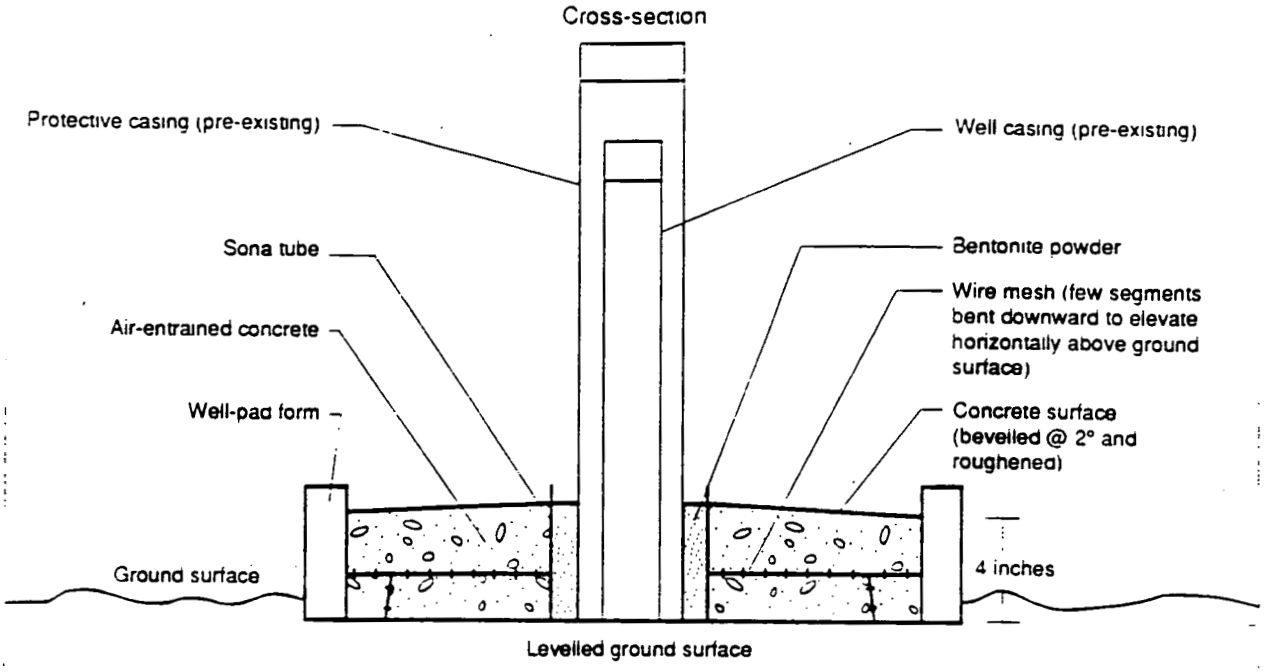
TYPICAL CONSTRUCTION OF BEDROCK WELL

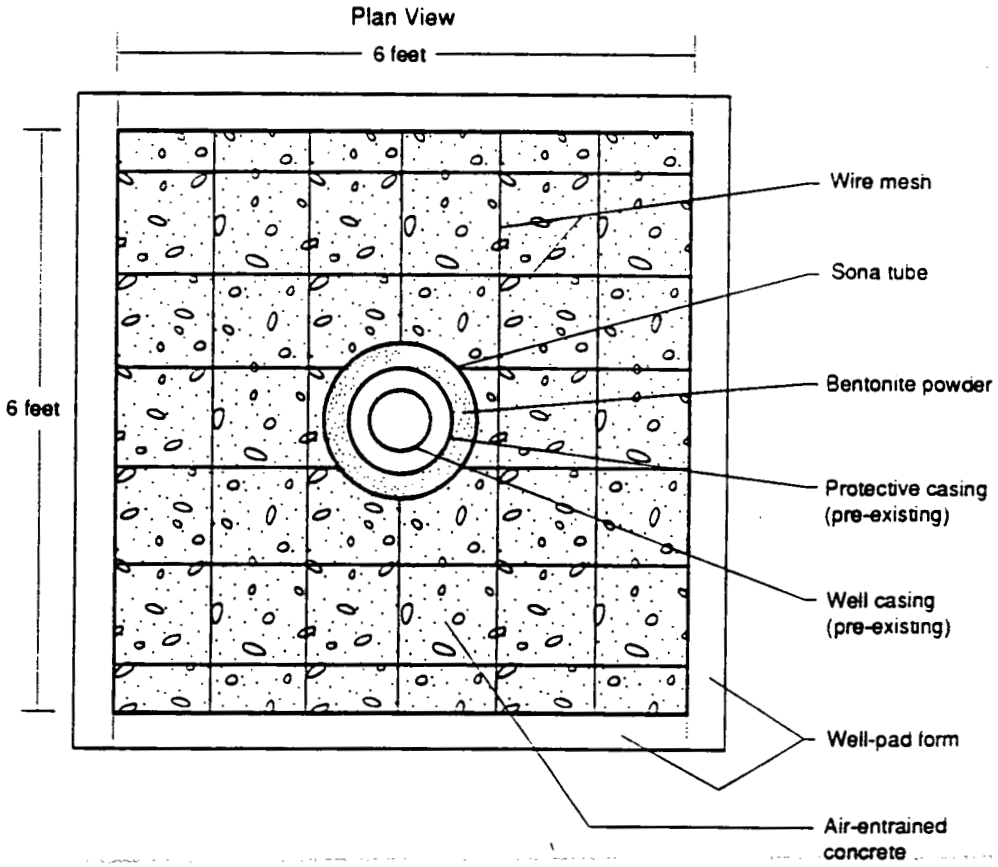


TYPICAL CONSTRUCTION OF BEDROCK WELL

APPENDIX 5.5

TYPICAL CONSTRUCTION OF WELL APRON

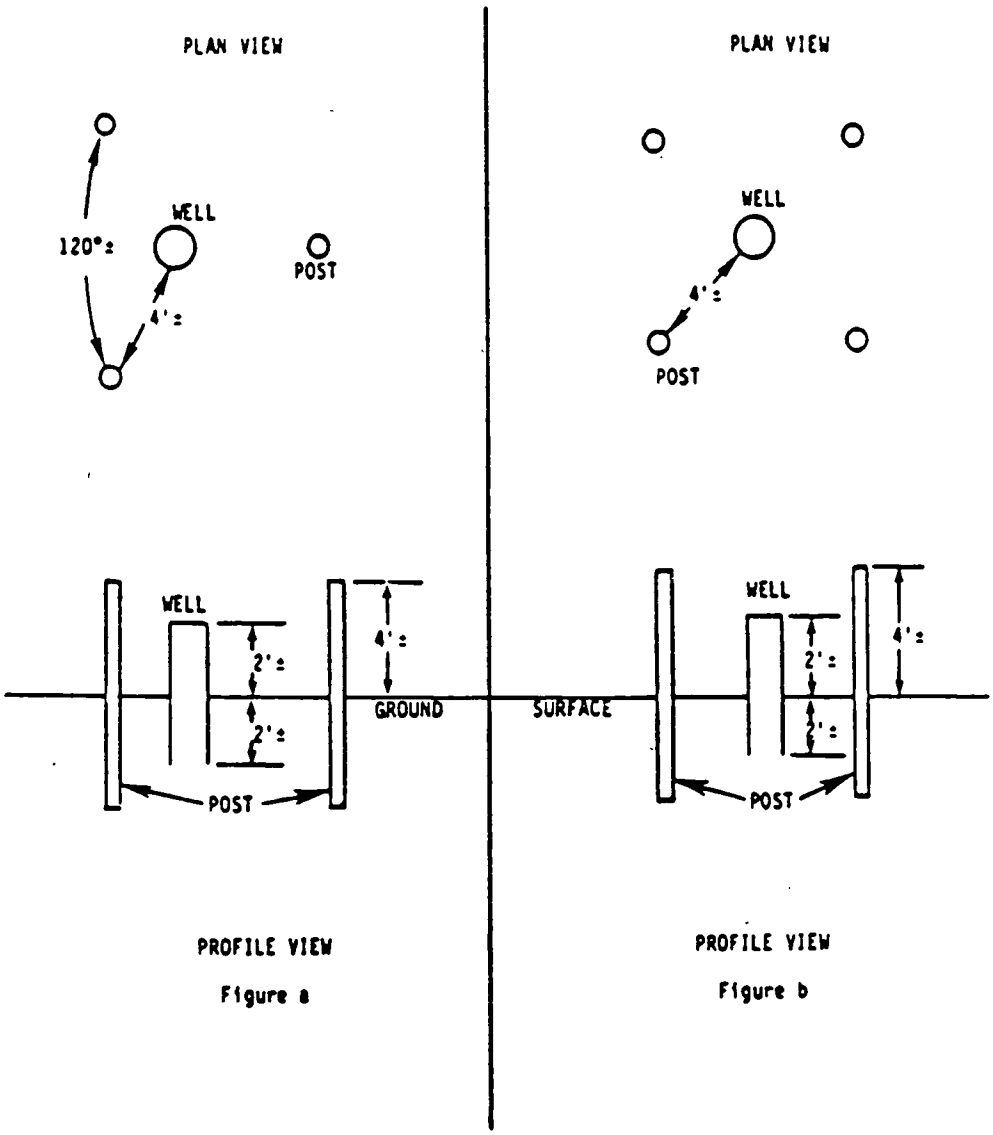




Appen5.5 2-24-92

APPENDIX 5.6

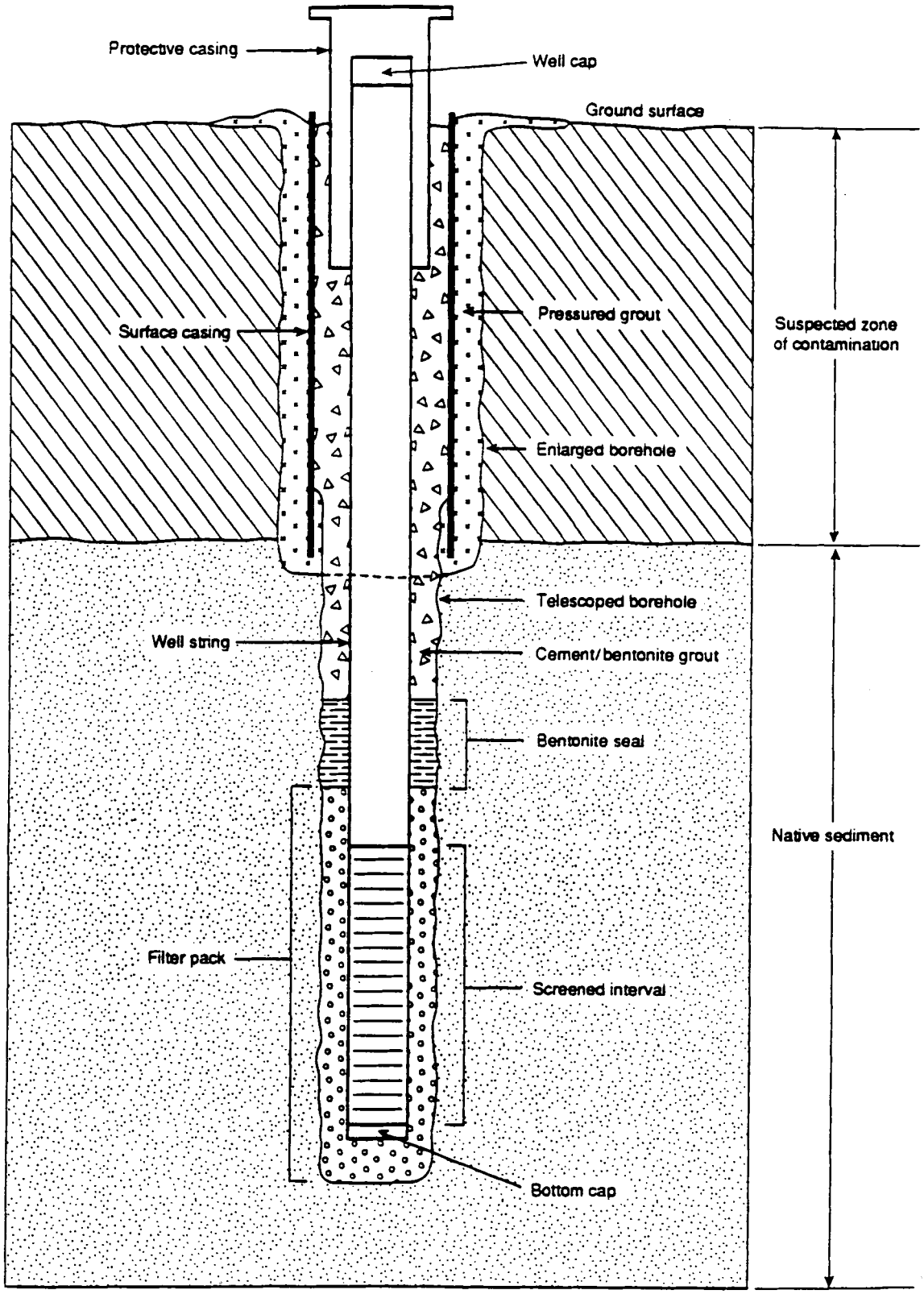
POST PLACEMENT AROUND WELL



POST PLACEMENT AROUND WELL

APPENDIX 5.7

TYPICAL CONSTRUCTION OF TELESCOPED WELL WITH SURFACE CASING



Appen5.7 2-24-92

APPENDIX 5.8

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

WELL COMPLETION INFORMATION FORM

1. Facility code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. A four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

3. Acceptance Code. One-character code assigned by the installation manager.

4. Owner Code. A three-character or four-character code identifying the owner of a well that is being installed.

5. Installer Code. Three-character or four-character code identifying the company responsible for installing and completing a well.

6. Installation Date. The date when the well was installed in the format DD-MMM-YY (01-JAN-88).

7. Filter Pack Length (Ft). The length of the filter pack surrounding the screened portion of the casing.

8. Formation of Completion (US/RC). (US/RC) designation.

9. Well Type Classification. One-character code that designates the type of well being constructed. Valid codes are listed on page 1 of the Well Completion Information form.

10. Well Completion Method. One-character code describing the method used to complete a well or the nature of the openings that allow water to enter a well. Valid codes are listed on page 1 of the Well Completion Information form.

11. Zone of Completion. One-character code designating the basic water-bearing zones at which a well is completed. Valid codes are listed on page 1 of the Well Completion Information form.

12. Casing Elevation (Ft MSL). Top of casing elevation. Casing elevation will be filled out at completion of the field investigation.

13. Casing Length (Ft). Distance from the top of casing (in feet and tenths of feet) at which the bottom of the casing is placed.

14. Casing Diameter (In). Diameter of casing installed in inches.

15. Seal End Depth (FTFD). Depth below ground surface (in feet and tenths of feet) at which the bottom of the seal is placed.

16. Screen Material. A two-character code describing the type of screen material. Valid codes are listed on page 2 of the Well Completion Information form.

17. Riser Material. A two-character code describing the riser material. Valid codes are listed on page 1 of the Well Completion Information form.

18. Open/Screen Depth (FTFD). Depth in feet and tenths of feet from top of casing to top of screen.

19. Open/Screen Length (Ft). Total length of the screen in feet and tenths of feet.

20. Open/Screen Area (In^2/Ft). Open area of screen in inches squared per foot.

21. Flow Relationship. One-character code designating the flow relationship. Valid codes are listed on page 1 of the Well Completion Information form.

22. Cap Material. Two-character code describing the cap material. Valid codes are listed on page 1 of the Well Completion Information form.

23. Cap Type. A two-character code describing the type of cap used in the installed well. Valid codes are listed on page 2 of the Well Completion Information form.

24. Comments. Any additional information.

APPENDIX 5.8, Continued

BOREHOLE/WELL CONSTRUCTION FIELD DATA LOG

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. A four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

3. Field Rep. The name of the field representative.

4. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

5. Driller code. Three-character or four-character code identifying the company responsible for drilling the borehole.

6. Rig Type. Manufacturer and model of rig.

7. Installer Code. Three-character or four-character code identifying the company responsible for installing and completing a well.

8. Completion Date. Date when well was completed in the format DD-MMM-YY (01-JAN-88).

9. Acceptance Code. One-character code assigned by the facility manager.

10. Borehole Summary

    a. Bit Type. The type of bit used.

    b. Hole Diam (In). Diameter of borehole in inches.

    c. End Depth (Ft). Depth from the ground surface to the bottom of the borehole (in feet and tenths of feet).

    d. Fluid Type. Type of fluid used during the drilling phase of well installation.

11. Casing Summary

    a. Casing Type. One-character code describing the type of casing material used. The codes are listed below.

    b. Description. Describes the casing materials used (for example, Schedule 40 PVC) in well construction.

c. Diameter (In). Diameter of casing in inches.

d. End Depth (Ft). Depth (in feet and tenths of feet) from the top of the casing to the bottom of the casing.

12. Well Construction

a. Type Code. One-character code describing the material used for filling the annulus space in borehole.

b. Description. Describes the materials used in well construction (bentonite pellets, for example) to fill the annulus space in borehole.

c. End Depth (Ft). Depth (from the ground surface) where the materials for well construction are placed in the borehole in feet and tenths of feet.

13. Construction Time Log

a. Start Date. The date construction started.

b. Start Time. The time construction started.

c. End Time. The time when construction ended.

14. Well Development. Any further developments during well construction.

15. Comments. Any additional information.

STANDARD OPERATING PROCEDURE 4.4

MONITORING WELL DEVELOPMENT

1. PURPOSE

To remove foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the monitoring well.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the method and equipment to be used for developing the monitoring well. Collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

Monitoring well development removes the fines from the well or aquifer formation near the screen and corrects damage that occurs during drilling. All well installation procedures create a skin on the borehole wall. There are four primary methods for developing monitoring wells: overpumping, rawhiding, jetting, and surging.

A. Overpumping involves pumping the well down as low as possible and allowing it to refill. The increased velocities created by refilling remove fines. This method is not very effective, because the water flow is in one direction and at relatively low velocities.

B. Rawhiding is a modification of overpumping. After the water is pumped to the surface, it is either allowed to run back into the well through a foot valveless pump or poured back down the well. This method generates two-directional flow and is superior to overpumping.

C. Jetting involves lowering a pipe into the well with a series of water jets on the end. The jets point horizontally. The high-pressure water pumped through the jets flushes fines from the formation and breaks the skin caused by drilling. As with the other methods, fines must occasionally be pumped from the well during development. An external water supply is needed for jetting. External water is introduced into the formation and alters the hydrochemistry. These are two major disadvantages of the jetting method.

D. Surging involves raising and lowering a surge or swab block inside the well. The resulting motion of the water removes the borehole skin and fines from the formation. The fines and water must occasionally be removed from the well with a sand bailer to prevent sand locking of the surge block. The rubber or viton seals on the surge block are the same diameter as the inside of the well or 1/2 inch smaller if surging is conducted inside the screened interval. A 3-ft stroke is typical.

Surging can also be implemented with high-pressure air. A high-pressure air pipe is lowered into the well, and surges of air are introduced. Water may be literally blown out of the top of the well, and water can be pumped out as the air surging progresses. However, air surging can introduce air into the formation (altering the hydrochemistry) and become entrained in the screens (reducing flow rates). Plastic screens can also be damaged if the air surge is too violent. A specially fabricated air swab can be used to prevent these types of damage.

E. Surging with a vented (pressure-relief) block (Appendix 5.2) and rawhiding are the preferred methods for well development, although no one method is appropriate for all situations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement
4.3	Monitoring Well Installation
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1 Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. If samples are to be collected for analyses, notify the laboratory of sample types, the number of samples, and the approximate arrival date. In addition, contact the carrier that will transport samples to obtain information on regulations and specifications.

F. Ensure that permission to discharge development water has been obtained or coordinate efforts to purchase appropriate containment vessels for development.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Decontaminate all equipment before developing each well according to SOP 1.6, General Equipment Decontamination.

B. Assemble containers for the temporary storage of water produced during well development. The containers must be structurally sound, compatible with anticipated contaminants, and field manageable.

NOTE: Truck-mounted tanks may be required for this operation.

3.3. Operation

Perform the development as soon as practical after well installation, but no sooner than 48 hrs after grouting is completed. Do not use any dispersing agents, acids, or disinfectants to enhance the development of the well. Do not add water to aid development except under the special conditions defined below. If problems or unusual conditions are encountered, notify the site manager as soon as possible.

A. Assemble the necessary equipment on a plastic sheet outside of the splash range.

B. Record pertinent information in the logbook and on the Well Completion Information form. A copy of this form and instructions for completing the form are provided in SOP 4.3, Monitoring Well Installation.

C. Open the monitoring well and take the air monitoring reading at the top of the casing and in the breathing zone (see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector).

D. Measure depth-to-water and the total depth of the monitoring well according to SOP 3.1, Water Level Measurement.

E. Develop the well until the well is free of sediment and the appropriate volumes of water have been removed (see E.4. below). Sediment free is loosely defined as 0.01 ml of sediment in a 1000-ml Imhoff cone. If the well is not free of sediment after the appropriate volumes of water have been removed, continue until twice the appropriate volume of water has been removed. Do not exceed twice the volume without consulting the site manager.

1. Note the initial color, clarity, and odor of the water.

2. Measure and record the initial pH, temperature, and specific conductance of the water according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

3. Containerize all water produced by development in contaminated areas or areas suspected of contamination. Clearly label each container with the location ID. Base the determination of an appropriate disposal method on the first round of analytical results from each well.

4. For those wells where the boring was installed <u>without</u> the use of drilling fluid (bentonite mud or water), remove 5 times the standing water volume in the well (well screen and casing plus saturated annulus). Should recharge be so slow that 5 volumes could not be removed in one day or the water is not sediment free after this 5-volume removal, the site manager will select an alternate procedure for verifying that the well is properly developed.

5. For those wells that cannot be cleaned of formation fines (clays and silts) resulting in low yields of formation water, small amounts of project-approved potable water should be added to the well bore. Once the majority of fines have been removed from the well, continue development with formation water only. During this process, it is essential that at least 5 times the amount of water injected must be withdrawn from the well to assure that all potable water has been removed from the formation. Do not add water to the well to assist development without prior approval by the site manager.

6. For those wells where the boring was installed/enlarged with the use of drilling fluid (bentonite mud or water), remove 5 times the measured amount of total fluids lost while drilling <u>plus</u> 5 times the standing water volume as defined above. Use the same procedure (of adding more water) for cases of slow recharge, discolored water, or water that is not sediment free.

7. Note the final color, clarity, and odor of the water.

8. Measure and record the final pH, temperature, and specific conductance of the water according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

9. Complete the appropriate data entry requirements on the Well Completion Information form to document well development. A copy of the form and instructions for completing it are in SOP 4.3, Monitoring Well Installation.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions as specified in the FSP or WP.

C. Make sure all monitoring well locations are properly staked and the location ID is readily visible on the protective casing.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. After the first round of analytical results have been received, determine and implement the appropriate water disposal method.

B. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

C. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

D. If samples have been collected for analysis, contact the laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

Gass, Tyler E., "Monitor Well Development." 1986. Water Well Journal 40, no. 1: 52-55.

Schalla, Ronald, and Robert W. Landick. 1986. "A New Valved and Air-Vented Plunger for Developing Small Diameter Monitor Wells," Ground Water Monitoring Review 6, no. 2: 77-80.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Surge Block Schematics

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ pH Meter

_____ Electrical conductivity meter

_____ Distilled water

_____ Stopwatch

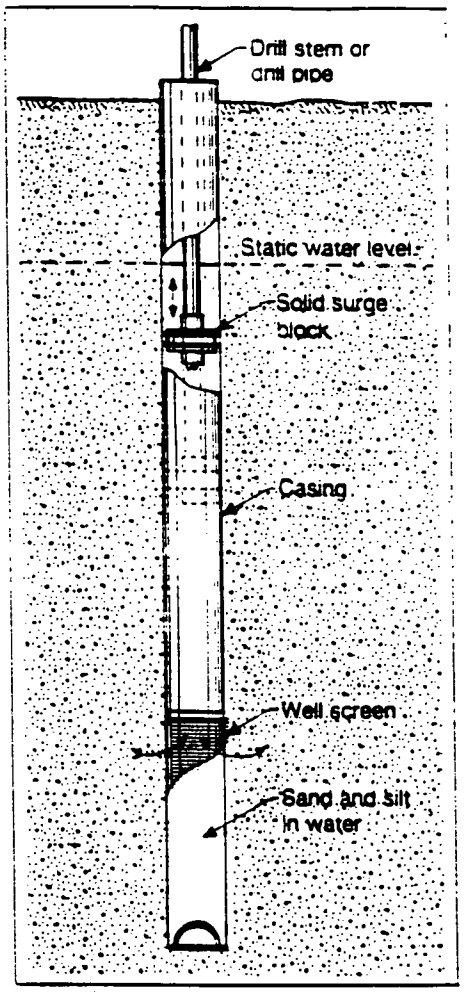
_____ Water level measurement probe

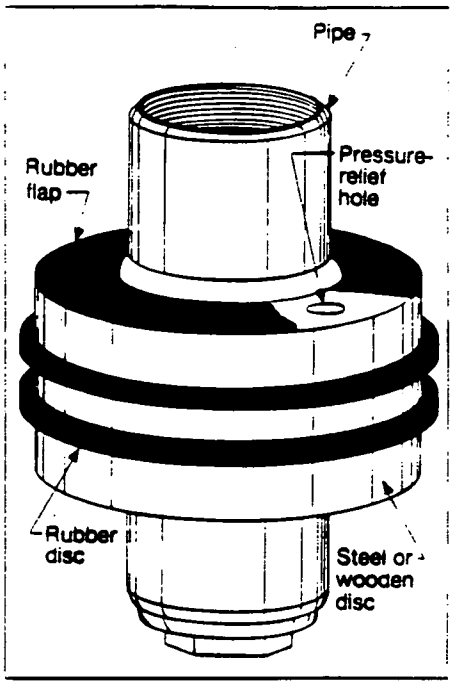
_____ 1000-ml Imhoff cone

_____ Plastic sheet

APPENDIX 5.2

SURGE BLOCK SCHEMATICS





STANDARD OPERATING PROCEDURE 4.7

PIEZOMETER INSTALLATION

1. PURPOSE

To ensure acceptable, consistent piezometer installation.

2. DISCUSSION

Piezometer installation creates a permanent access for measuring aquifer characteristics, primarily the static water table elevation. Ideally, the piezometer should not alter the medium that is being sampled.

The Field Sampling Plan (FSP) or Work Plan (WP) provides information about the scope and details of piezometer installation at a given site. A list of critical issues involved in piezometer installation are listed below.

- Soil/rock boring technique
- Casing and screen materials
- Casing and screen diameter, screen length and size, and screened interval
- Filter pack, annular seal, grout, protective cap, and protective casing

Piezometers will be installed with a minimum borehole diameter of 6 inches using appropriate drilling techniques. All piezometer construction materials should be chemically inert and also of sufficient integrity during piezometer development and use. Therefore, it is recommended that two-inch-diameter, Schedule-40 PVC, 0.010-inch slot well screen be coupled with 2-inch-diameter, Schedule-40 PVC riser pipe (or as specified in the work plan). The location and completion depth of each piezometer will be outlined in the applicable work plan or field sampling plan. A 5-ft long well screen is recommended for most piezometer installations in order to monitor seasonal variations in the static water table. Well screens greater or less than 5 ft in length can be installed based on field conditions or as specified in the work plan. A quartz-sand filter pack, as specified in the work plan, will stem the annulus between the well string and the borehole wall from the bottom of the borehole to no more than 2 ft above the top of the well screen. Grain size of the geologic medium will be evaluated by the onsite geologist to confirm that the proper filter pack size is used. It is recommended that the filter pack be emplaced as a sand slurry (composed of silica sand and project-approved potable water) using a tremie pipe. This procedure will help the sand to settle and compact within the borehole annulus and prevent the sand from bridging along the well screen interval. During emplacement, the depth to the top of the filter pack will be frequently tagged using a weighted measuring measuring tape. A 2- to 4-ft interval of bentonite pellets or slurry will be emplaced on top of the filter pack using a tremie pipe. The bentonite will adequately seal the zone of completion. The remaining borehole annulus will be stemmed to the ground surface using a cement/bentonite grout mixture.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Borehole drilling, development of the piezometers, collection and measurement of samples, and the documentation of data will be performed as described in the associated procedures. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement
4.1	Soil Boring
4.2	Rock Boring
4.6	Piezometer Development
5.1	Soil and Rock Borehole Logging and Sampling
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Research site hydrogeology to estimate key parameters (for example, anticipated aquifer depth and thickness, types of contaminants, and grain-size distribution).

E. If water/sand slurry or grout is required, the source(s) of any water used must be approved by the site manager before field operations.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record all pertinent information (date, site, ID #, and location) in the logbook or on the appropriate form. Include field conditions, unusual circumstances, and weather. Instructions for logbook entries are in SOP 1.3, Sample Control and Documentation.

3.2.3. **Field**

A. Decontaminate all equipment before piezometer installation, as specified in SOP 1.6, General Equipment Decontamination.

3.3. **Operation**

A. Piezometers must be installed in such a manner as to minimize disturbance and prevent introduction of contaminants to the subsurface environment. This is especially important if rotary drilling techniques using circulation fluid are employed. Any use of solvents, glues, soap, or cleaners is prohibited below grade unless otherwise stated in the specifications. When they are used, describe the material and include the manufacturer and type (specification). The use of pipe dope, grease, and oil is also prohibited. However, the use of teflon pipe dope is acceptable.

B. Monitor downhole and the breathing zone according to SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector. Perform readings as often as necessary to ensure the safety of workers. Record all measurements on the data collection forms included with these SOPs.

C. Record all field measurements and comments on the Piezometer Information or the Borehole/Well Construction Field Data Log form. Complete all lines on the forms. Use the letter designation NA for not applicable, ND for not done, or UNK for unknown when applicable. If some steps or procedures were not performed as described, state the reason (as practicable) on the form or submit it as an attachment. Copies of these forms are in Appendix 5.1 and Appendix 5.2, respectively. Fill out the forms as described in Appendix 5.6. For a current list of codes used in the data form completion, consult the ER Program data administrator.

D. Record the diagram of the piezometer installation on the Piezometer Completion Information form and show the depth from surface grade, the bottom of the boring, sump, screen location, coupling design and location, granular backfill, seals, grout, cave-in, centralizers, and the height of the riser above the ground surface. Record the actual composition of the grout, seals, and granular backfill on each Borehole/Piezometer Construction Field Data Log form. Include the screen slot size (in inches), slot configuration, and screen manufacturer.

E. If appropriate, include the protective casing detail on all piezometer sketches.

F. If a quartz sand filter pack is specified, follow the instructions listed below.

1. Base the average grain size of the sand on the expected grain-size distributions in the screened formation and the size of predesigned well-screened openings. Use sand having a gradation that will allow no more than 10% of pack material to pass through the screen slots.

2. Take at least one sample (1/2 to 1 pint in size) from each shipment of granular material, assign an identification number, and store it with the soil samples. Record the identification number on the sketch of each installation for which that material was used.

3. The specifications of the proposed sand-pack material should be submitted by the contractor for approval before use. Describe each sample in terms of lithology, grain-size distribution, and source (company from which it was purchased and the pit or quarry of origin). This material should be clean, inert, and siliceous. Use well-sorted (poorly graded) sand, like No. 8-12 or a similar material, with approximately 10% passing the design slot size.

G. It is desirable that all padlocks at a given site can be opened by the same key. The numbers on the locks should be noted and then rubbed off the back.

H. Safety equipment should be specified by the site health and safety officer. In all cases, the minimum physical protection should include a hard hat, safety glasses, gloves, steel-toed leather boots, hearing protection, and coveralls for splash protection and cold weather.

I. Typical well construction features are in Appendixes 5.3 and 5.4. However, specific contract requirements may alter some of the components or values. After piezometer development (SOP 4.6) is complete, indicate the water level on the piezometer construction diagram of the Piezometer Completion Information Form (Appendix 5.1).

J. When applicable, use stainless steel centralizers to assure the uniform and complete annular filling by granular backfill, seal, and grout materials. Fasten centralizers to the well casing by mechanical fasteners and radially space them around the casing at 120° or 90° intervals. On the Borehole/Piezometer Construction Field Data Log form (Appendix 5.2),

provide a description of the fastening device and centralizer that includes their locations.

K. If specified, place a quartz sand filter pack in the annulus next to the well screen in all piezometers. The sand pack ensures continuous flow capability from the natural formation to the well bore.

1. Fill the annulus between the well screen and borehole wall with a sand slurry (composed of silica sand and project-approved potable water) using a tremie pipe. Frequently tag the depth to the top of the filter pack using a weighted measuring tape during this process to insure proper placement.

2. It is necessary to emplace sufficient sand slurry to stem the annular interval between the bottom of the borehole to no more than 2-ft above the top of the well screen after the sand pack has compacted and settled.

3. Ascertain the depth of the top of the sand with an acceptable measuring device or the tremie pipe and verify the thickness of the sand pack. If necessary, add more sand to bring the top of the sand pack to the proper elevation (no more than 2 ft above the top of the screen).

4. Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without the threat of cross flow between producing zones.

5. The site manager is the only individual authorized to modify an existing well design.

6. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during sand pack placement to the extent practical. Remove them as the level of the sand pack rises above the bottom of the augers.

L. Place a bentonite seal between the sand pack and grout to prevent infiltration of cement into the filter pack and the well screen. In special circumstances, an open borehole may be drilled to a depth below where the screen is set. If grout is used as backfill up to the proper level to seal off a lower aquifer, place a bentonite seal above the grout before the casing, screen, and sand pack are introduced. Allow the grout to set up for a minimum of 12 to 24 hrs before placing the seal. Place the bentonite seal in the monitoring well as described below.

1. Fill the annulus between the well casing and borehole with a bentonite seal at least 2- to 4-ft thick (vertically) above the filter pack.

2. For piezometers less than approximately 50-ft in depth, use bentonite pellets. The pellets should have a minimum purity of 90 percent montmorillonite clay and a minimum dry bulk density of 75 lb/ft^3 for 1/2-inch pellets (as provided by American Colloid) or the

equivalent. Pour the bentonite pellets directly down the annulus. Avoid introducing pellets into the well bore. Place a cap over the top of the well casing before pouring the bentonite pellets from the bucket. Pour the pellets from different points around the casing to ensure even application. A tremie pipe may be used to redistribute and level out the top of the seal.

3. For the piezometers deeper than approximately 50 ft, the bentonite seal may either be poured as pellets or introduced as a slurry. The method should be determined by the site manager after evaluating the condition of the well and borehole wall. If there are no centralizers in the upper portions of the casing, manipulate the casing to prevent pellets from hanging up in the narrow annulus and to allow them to settle to the bottom as rapidly as possible.

4. If a slurry of bentonite is used as annular seal, prepare the slurry by mixing powdered or granular bentonite with potable water. The slurry should be of sufficiently high specific gravity and viscosity to prevent its displacement by the grout that will be placed above. Regardless of depth and depending on fluid viscosity, a few handfuls of bentonite pellets may be dumped in to solidify the surface of the bentonite slurry as a precaution.

5. Before adding bentonite pellets or slurry, be sure the sand pack has ceased settling by measuring the depth of the top of the sand with the tremie pipe. The sand pack should provide an adequate cover over the screen.

6. If a bentonite slurry is used, visually check the condition of the slurry by pumping into a bucket or onto the ground. Retract the tremie pipe 3 ft from the top of the sand pack and begin pumping.

7. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during bentonite seal placement to the extent practical. Remove them as the level of the bentonite rises above the bottom of the augers.

8. In all situations, use a 2 to 4-ft bentonite seal. Tag the top of the seal by an acceptable measuring device or tremie pipe to verify that the proper thickness of seal has been placed in the annulus.

9. Until the specified quantity of bentonite has been placed in the well annulus, repeat the application and verification.

M. Place grout from the top of the bentonite seal to the surface and allow a minimum of 24 to 48 hrs after the bentonite seal has been placed to allow it to set up. Only Type I or Type II cement without accelerator additives may be used. Place grout in the monitoring wells as described below.

1. Fill the annulus between the well casing and borehole wall with grout.

2. Place the grout from a grout tremie pipe.

3. The tremie pipe should normally consist of 1.25-inch PVC or steel pipe. One-inch rolled, thin-walled polypipe has been used with success in some cases.

4. Pump the grout through this pipe to the bottom of the open annulus until undiluted grout flows from the annulus at the ground surface.

5. The grout should consist of a neat cement mix composed of 4 lbs of commercial bentonite and approximately 7.5 gallons of water added to each 94-lb bag of cement. Use only grout mixed with approved water.

6. In materials that will not maintain an open hole, leave the hollow-stem augers in the hole during grouting to the extent practical. Remove them as the level of the grout rises above the bottom of the augers.

7. While the grout is still green, add more grout to compensate for the removed casing or auger and tremie pipe and to ensure that the top of the grout is at or above the ground surface.

8. The protective casing should now be installed.

9. After the grout has set (about 48 hrs), fill any depression in the grout caused by settlement with a grout mix similar to that described above.

N. Install protective casing around all piezometers. Exceptions may be made on a case-by-case basis. The minimum elements in the protection design include those listed below.

1. The protective steel cap should keep precipitation out of the protective casing and should be secured to the casing by padlocks.

2. Set a 5-ft (minimum) length of black iron pipe or galvanized pipe so that the top of the pipe is about 1.5 to 3 ft above the ground surface and grout it in place as shown in Appendixes 5.3 and 5.4.

3. Use the pipe diameter of 8 inches for 4-inch wells and 6 inches for 2-inch wells (depending on approved borehole size). A drain hole near ground level that is 0.5 inch in diameter is permitted.

4. Provide a protective steel cap and secure it to the top of each protective casing.

5. Mark the location ID on the inside and outside of the cover with indelible ink and on the protective casing with paint.

O. Install a concrete well apron or pad around each monitoring well as shown in Appendix 5.5. The apron will be constructed with minimum radius of 3 ft (6 by 6 ft) and 4 inches thick. The body of the apron should contain a 4- by 4-inch wire mesh to reinforce the structure. The concrete surface should be roughened for traction and bevelled at an angle of 2 degrees to drain runoff. A 10-inch diameter sona tube should surround the protective casing, with bentonite powder filling the annulus between the casing and the tube. This will prevent the apron from

cracking during periods of frost heave. A surveyor's pin stamped with the well location ID should be installed on the well apron surface before the concrete hardens.

P. The installation of guard posts around the periphery of the well apron is recommended in areas where vehicle traffic might pose a hazard.

Guard posts shown in Appendix 5.5 consist of steel posts that are 3 inches in diameter or tee-bar driven steel posts. Three are radially located 4 ft around each well and driven 2 ft below the ground surface, having a minimum of 4 ft above the ground surface with flagging in areas of high vegetation. Each post should be cemented in place.

Q. Drilling through a suspected zone of contamination within the vadose zone could create a more permeable conduit for infiltrating groundwater to enter and leach potential contaminants to the static water table. The following protocols are supplemental to information described in Section 3.3 for borehole drilling and installation of monitoring wells in this type of situation. Borehole and well construction details are shown in Appendix 5.7.

1. Use appropriate drilling techniques to collect continuous core.

2. Monitor core for volatile vapors as described in Section 3.3.B.

3. Examine core as described in SOP 5.1, Soil and Rock Borehole Logging and Sampling, to determine the vertical extent of contaminated soils.

4. Remove drill string and enlarge the borehole to 1 ft below the base of the zone of contamination.

5. Set surface casing from the bottom of the enlarged borehole to the ground surface and pressure grout the annulus between the outside of the surface casing and the borehole wall. Use Type I or Type II cement without accelerator additives. The grout should be mixed according to specifications outlined in Section 3.3.M.5.

6. Allow a minimum of 24 hours for the grout to set up.

7. Trip the drill string to the base of the surface casing and drill a telescoped borehole to the depth specified in the applicable work plan or field sampling plan.

8. Install the monitoring well according to specifications outlined in Section 3.3.

R. In the event that a borehole must be abandoned for failure to reach the specified depth (or any other cause), grout the borehole with a tremie pipe from the bottom up with grout mixed to the specifications described in Section 3.3.M.5.

S. In the event that a well must be abandoned for failure to reach specified depths, loss of tools, or inadvertent contamination, rip the screened

interval with an appropriate tool. Grout the well with a tremie pipe (from the bottom up) with grout mixed to the specifications described in Section 3.3.M.5.

3.4 Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to predrilling conditions as specified in the FSP or WP.

C. Make sure all monitoring wells are properly labeled and the location ID is readily visible on the protective casing.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

DOE. 1985. "Field Technical Representative Manual." 2d ed. U.S. Department of Energy, Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office document, June 1985. Albuquerque, New Mexico.

5. APPENDIXES

5.1. Piezometer Completion Information Form

5.2. Borehole/Piezometer Construction Field Data Log Form

5.3. Typical Construction of Overburden Piezometer

5.4. Typical Construction of Bedrock Piezometer

5.5. Typical Construction of Piezometer Apron

5.6. Post Placement Around Piezometer

5.7. Typical Construction of Telescoped Piezometer with Surface Casing

5.8. Data Form Completion

APPENDIX 5.1

PIEZOMETER COMPLETION INFORMATION FORM

PIEZOMETER COMPLETION INFORMATION PAGE 1 OF 2

FACILITY CODE _____ FILTER PACK LENGTH (FT) _____

LOCATION ID _____ FORMATION OF COMPLETION (US/RC) _____

ACCEPTANCE CODE _____ WELL TYPE CLASSIFICATION _____

OWNER CODE _____ WELL COMPLETION METHOD _____

INSTALLER CODE _____ ZONE OF COMPLETION _____

INSTALLATION DATE _____

CASING ELEVATION (FT MSL) _____ OPEN/SCREEN DEPTH (FTFD) _____

CASING LENGTH (FT) _____ OPEN/SCREEN LENGTH (FT) _____

CASING DIAMETER (IN) _____ OPEN/SCREEN AREA (IN^2 /FT) _____

SEAL END DEPTH (FTFD) _____ FLOW RELATIONSHIP _____

SCREEN MATERIAL _____ CAP MATERIAL _____

RISER MATERIAL _____ CAP TYPE _____

WELL TYPE CLASSIFICATION:
- M – MONITOR WELL
- P – PRODUCTION WELL
- T – TEST WELL
- O – OTHER (SPECIFY)

CAP TYPES:
- LC – LOCKING
- SL – SLIP–ON
- TR – THREADED
- NO – NONE
- SC – SCREW ON
- OT – OTHER (SPECIFY)

CASING, CAP, RISER MATERIALS :
- BR – BRICK
- C1 – CONCRETE
- C2 – COPPER
- FI – FIBERGLASS
- GI – GALVANIZED IRON
- WI – WROUGHT IRON
- SS – STAINLESS STEEL
- OM – OTHER METAL
- TE – TEFLON
- PV – PVC
- RS – ROCK OR STONE
- ST – STEEL
- TI – TILE
- CS – COATED STEEL
- WO – WOOD
- NO – NONE
- OT – OTHER (SPECIFY)

FLOW RELATIONSHIPS:
- U – UPGRADIENT
- D – DOWNGRADIENT
- C – CROSS GRADIENT
- O – ON SITE
- N – NOT KNOWN
- B – BACKGROUND

ZONES OF COMPLETION:
- A – ARTESIAN
- B – ANISOTROPIC
- C – CONFINED
- H – AQUITARD
- G – AQUICLUDE
- I – ISOTROPIC
- M – MULTI–SYSTEM
- S – SEMI–CONFINED
- U – UNCONSOLIDATED

WELL COMPLETION METHODS:
- C – POROUS CONCRETE
- F – GRAVEL PACK
- H – HORIZONTAL GALLEY
- O – OPEN END
- P – PERFORATED/SLOTTED
- S – SCREEN
- T – SAND POINT
- W – WALLED OR SHORED
- X – OPEN
- O – OTHER (SPECIFY)

NOTE : FTFD = FEET FROM DATUM

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
WCD–008 (3/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

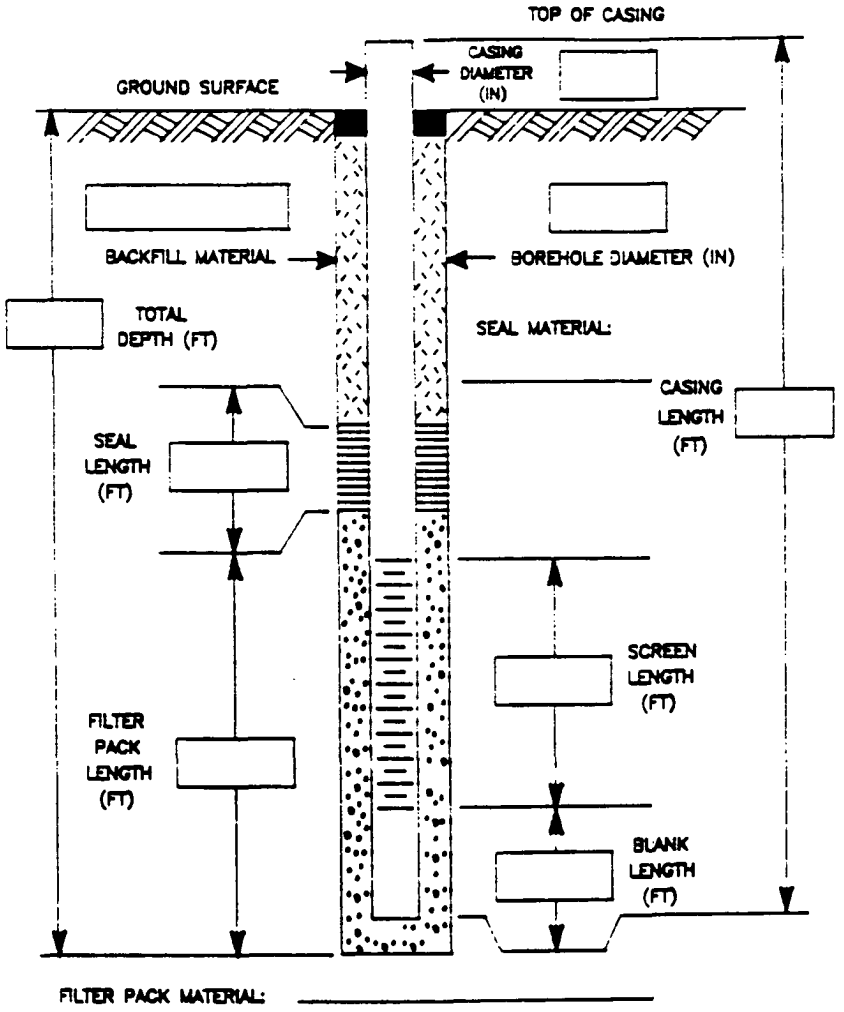
APPENDIX 5.1, Continued

PIEZOMETER COMPLETION INFORMATION FORM

PIEZOMETER COMPLETION INFORMATION PAGE 2 OF 2

FACILITY CODE _____

LOCATION ID _____ **INSTALLATION DATE** _____



FILTER PACK MATERIAL: _____

COMMENTS _____

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

WCD-008 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.2

BOREHOLE/PIEZOMETER CONSTRUCTION FIELD DATA LOG

BOREHOLE/PIEZOMETER CONSTRUCTION FIELD DATA LOG

FACILITY CODE _____ LOCATION ID _____ FIELD REP _____

LOGGER CODE _____ DRILLER CODE _____ RIG TYPE _____

INSTALLER CODE _____ COMPLETION DATE _____ ACCEPTANCE CODE _____

BOREHOLE SUMMARY

BIT TYPE	HOLE DIAM (in)	END ● DEPTH (ft)	FLUID TYPE

CASING SUMMARY

CASING* TYPE	DESCRIPTION	DIAM (in)	END ▲ DEPTH (ft)

* P – Protective S – Screen O – Open N – None

▲ Depth from Top of Casing

WELL CONSTRUCTION

TYPE* CODE	DESCRIPTION	END ● DEPTH (ft)

* B – Backfill S – Seal F – Filter Pack

● Depth From Ground Surface

CONSTRUCTION TIME LOG

ACTIVITY	START DATE	START TIME	END TIME
DRILLING			
CASING			
FILTER PACK			
SEAL			
BACKFILL			
DEVELOPMENT			
OTHER			

WELL DEVELOPMENT

COMMENTS _____

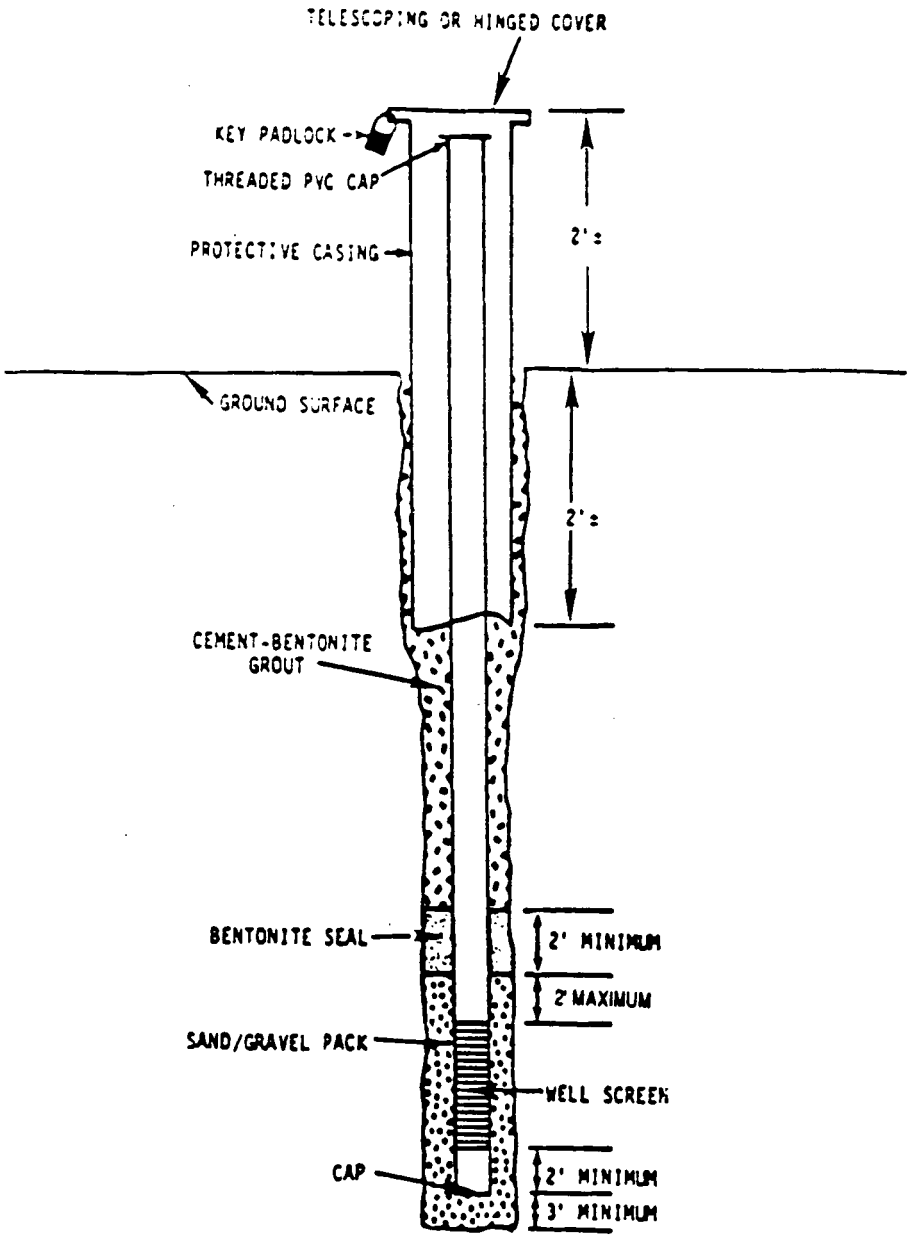
ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

SWD-044 (1/88) FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

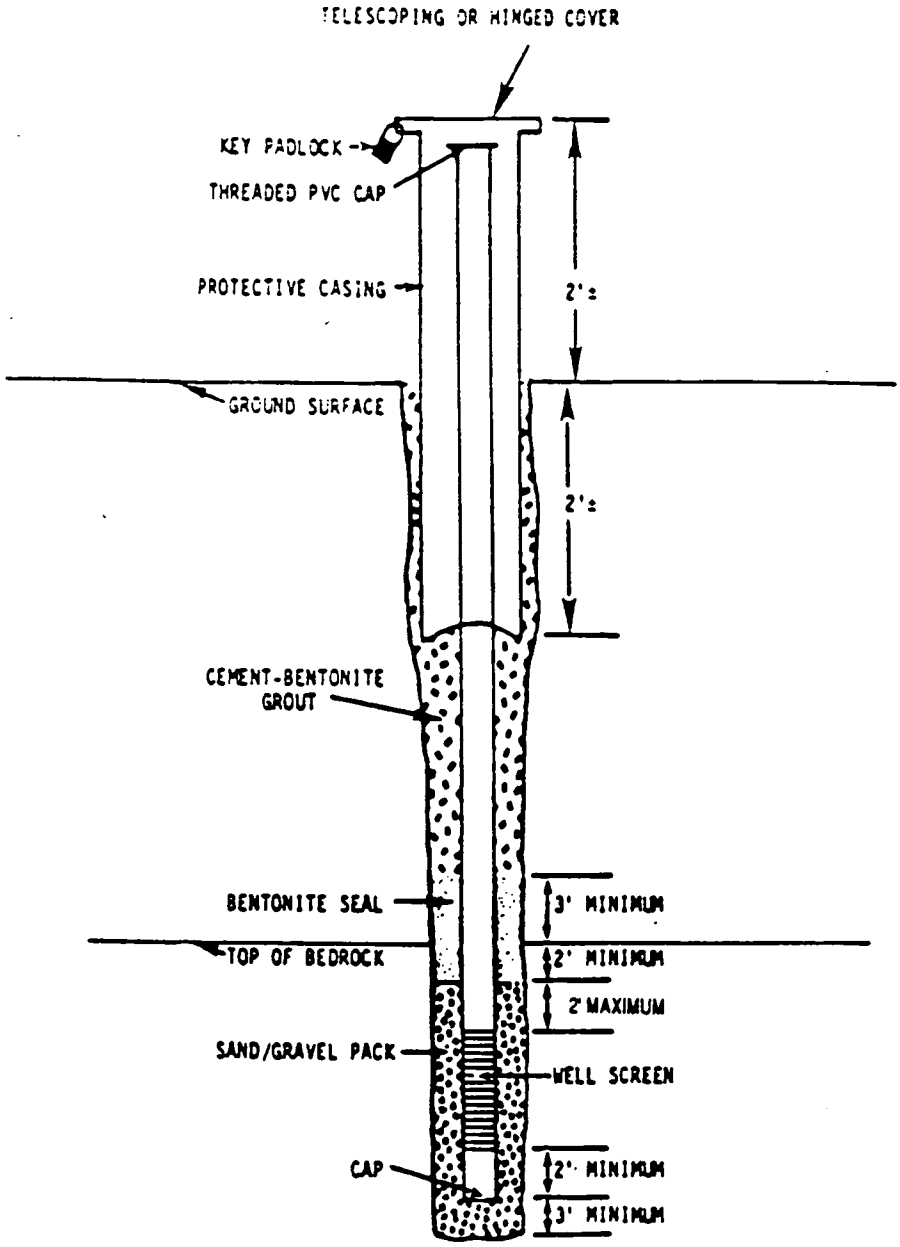
TYPICAL CONSTRUCTION OF OVERBURDEN PIEZOMETER



TYPICAL CONSTRUCTION OF OVERBURDEN WELL

APPENDIX 5.4

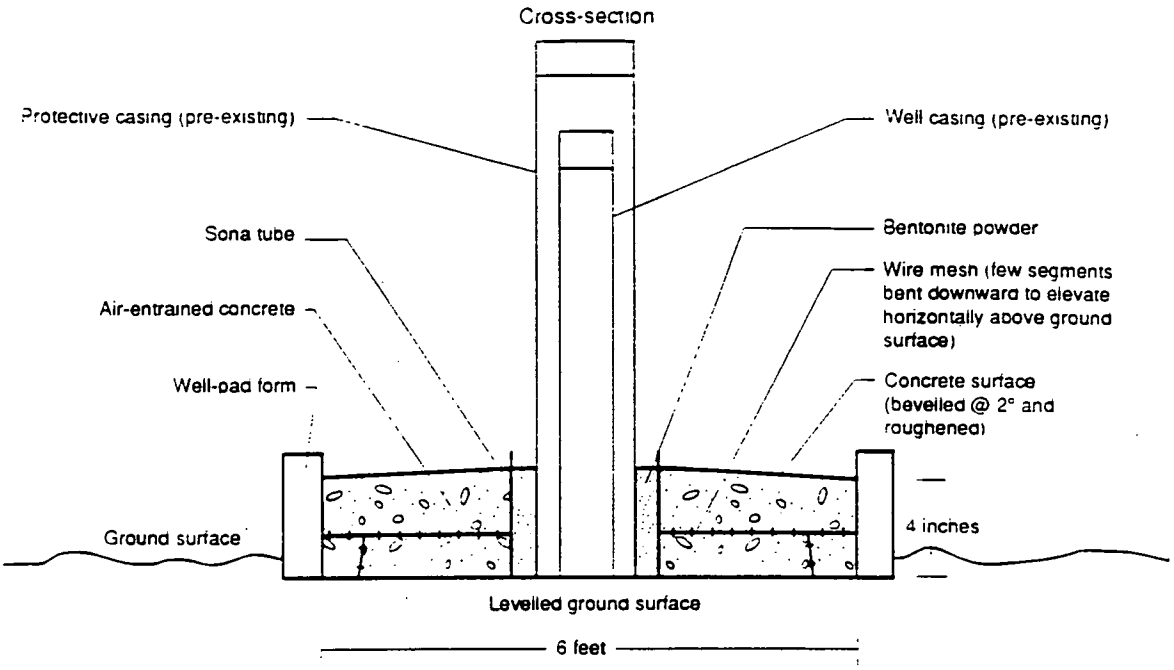
TYPICAL CONSTRUCTION OF BEDROCK PIEZOMETER

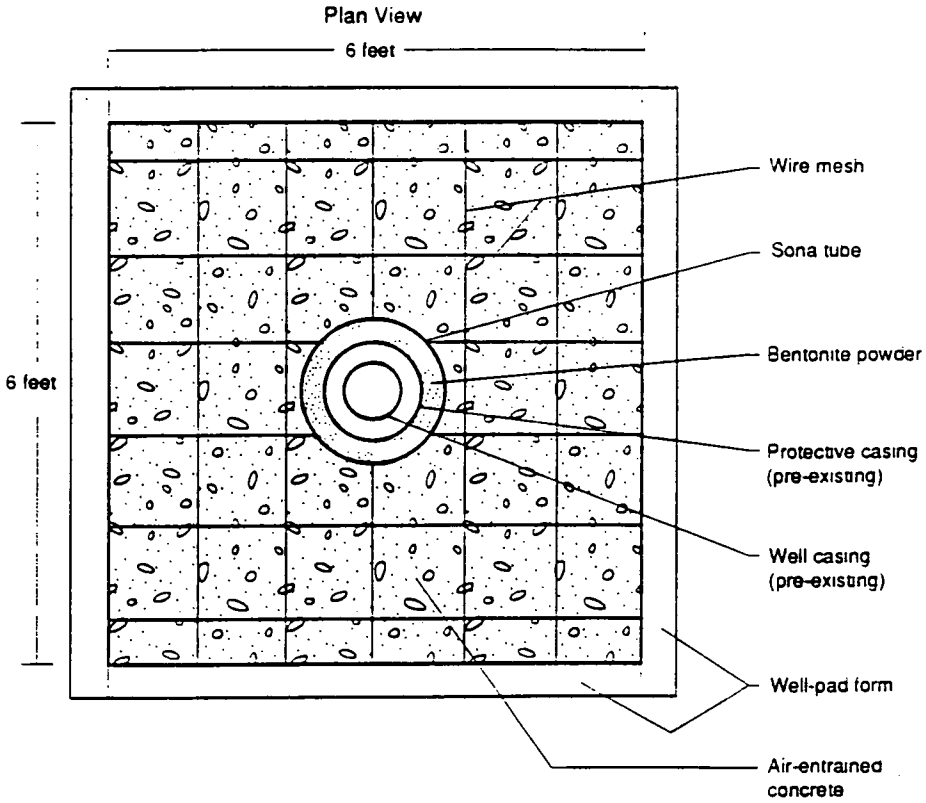


TYPICAL CONSTRUCTION OF BEDROCK WELL

APPENDIX 5.5

TYPICAL CONSTRUCTION OF PIEZOMETER APRON

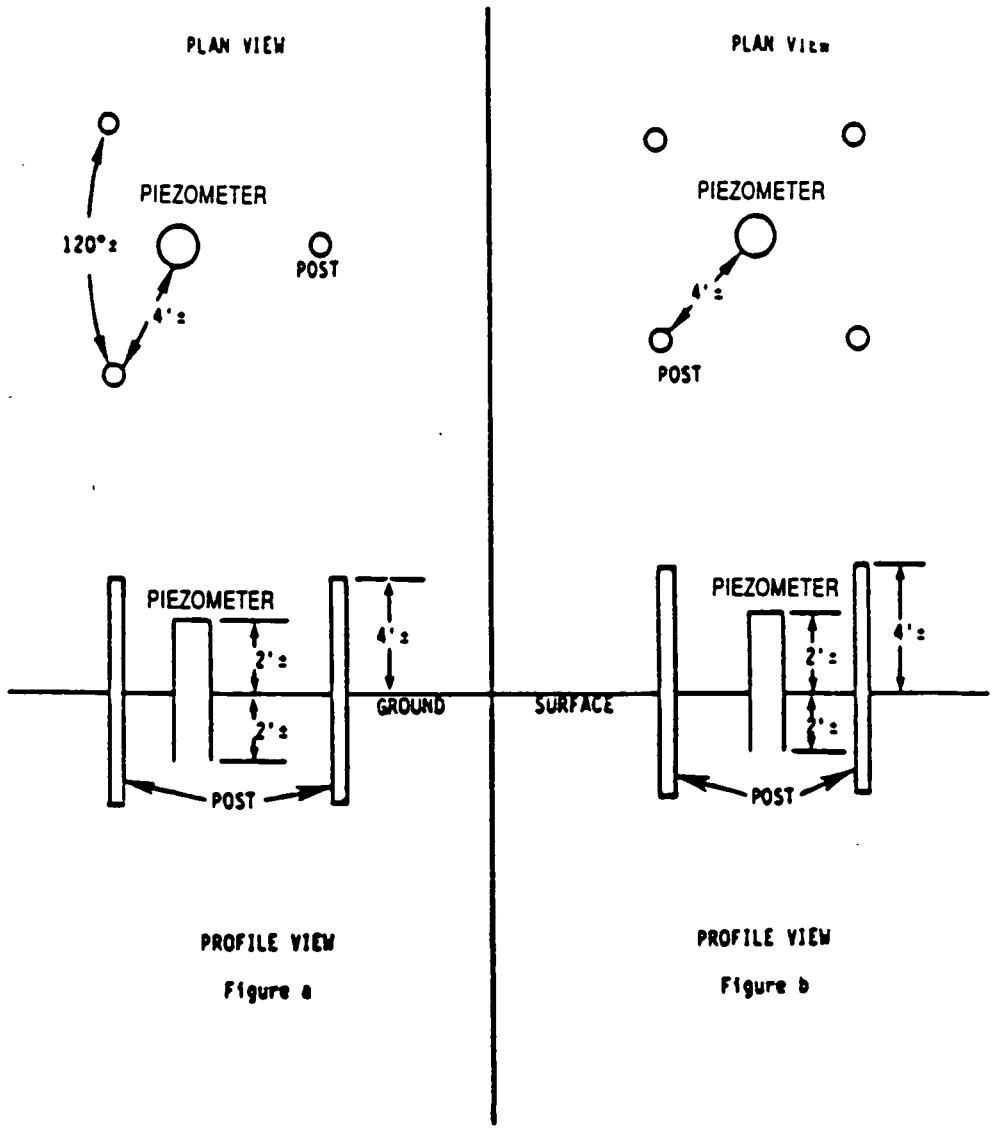




Appen5.5 2-24-92

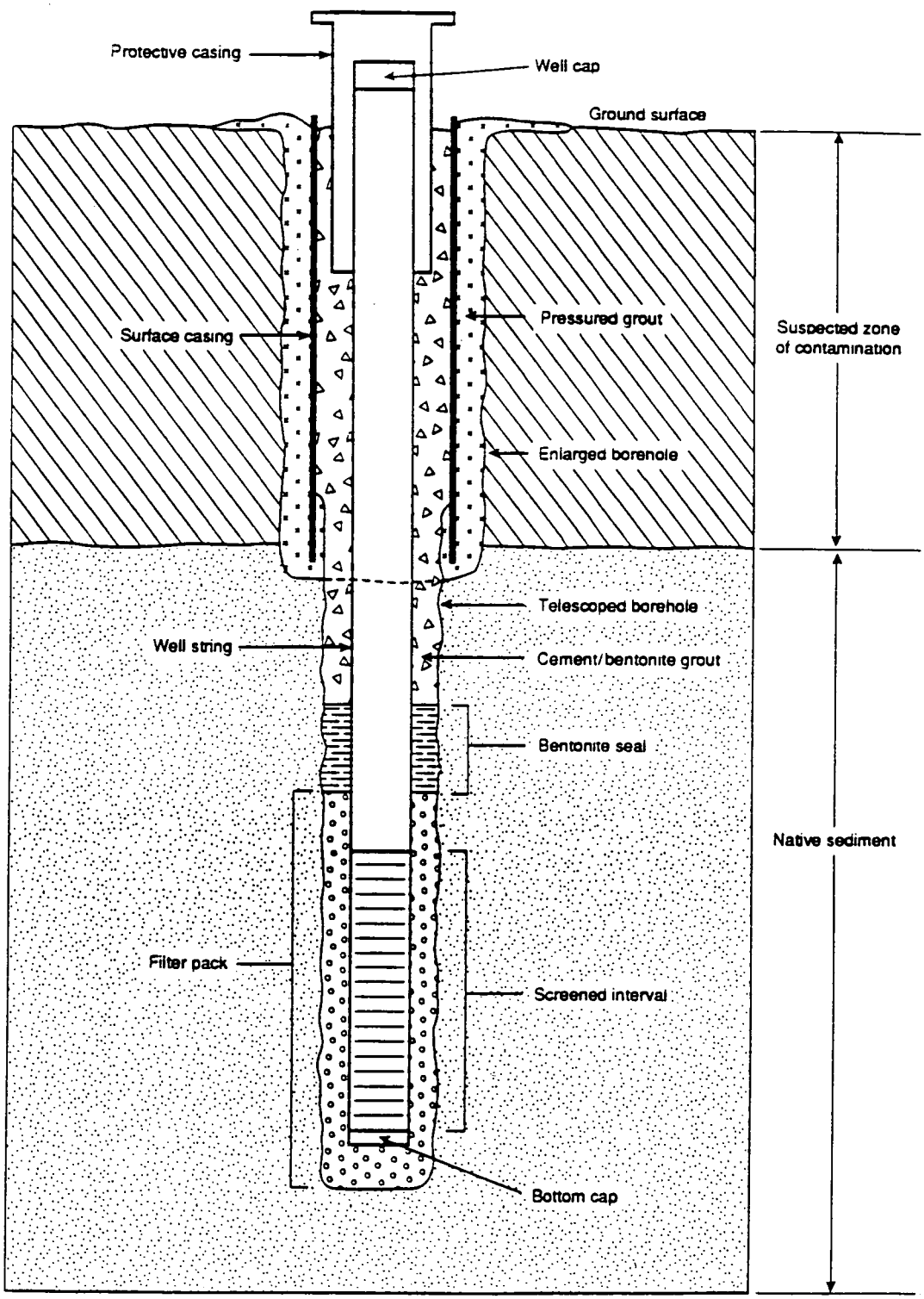
APPENDIX 5.6

POST PLACEMENT AROUND PIEZOMETER



APPENDIX 5.7

TYPICAL CONSTRUCTION OF TELESCOPED PIEZOMETER WITH SURFACE CASING



Appen5.7 2-24-92

APPENDIX 5.8

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PIEZOMETER COMPLETION INFORMATION FORM

1. Facility code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. A four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

3. Acceptance Code. One-character code assigned by the installation manager.

4. Owner Code. A three-character or four-character code identifying the owner of a piezometer that is being installed.

5. Installer Code. Three-character or four-character code identifying the company responsible for installing and completing a piezometer.

6. Installation Date. The date when the piezometer was installed in the format DD-MMM-YY (01-JAN-88).

7. Filter Pack Length (Ft). The length of the filter pack surrounding the screened portion of the casing.

8. Formation of Completion (US/RC). (US/RC) designation.

9. Well Type Classification. One-character code that designates the type of well being constructed. Valid codes are listed on page 1 of the Piezometer Completion Information form.

10. Well Completion Method. One-character code describing the method used to complete a well or the nature of the openings that allow water to enter a well. Valid codes are listed on page 1 of the Piezometer Completion Information form.

11. Zone of Completion. One-character code designating the basic water-bearing zones at which a piezometer is completed. Valid codes are listed on page 1 of the Piezometer Completion Information form.

12. Casing Elevation (Ft MSL). Top of casing elevation. Casing elevation will be filled out at completion of the field investigation.

13. Casing Length (Ft). Distance from the top of casing (in feet and tenths of feet) at which the bottom of the casing is placed.

14. Casing Diameter (In). Diameter of casing installed in inches.

15. Seal End Depth (FTFD). Depth below ground surface (in feet and tenths of feet) at which the bottom of the seal is placed.

16. Screen Material. A two-character code describing the type of screen material. Valid codes are listed on page 2 of the Piezometer Completion Information form.

17. Riser Material. A two-character code describing the riser material. Valid codes are listed on page 1 of the Piezometer Completion Information form.

18. Open/Screen Depth (FTFD). Depth in feet and tenths of feet from top of casing to top of screen.

19. Open/Screen Length (Ft). Total length of the screen in feet and tenths of feet.

20. Open/Screen Area (In^2/Ft). Open area of screen in inches squared per foot.

21. Flow Relationship. One-character code designating the flow relationship. Valid codes are listed on page 1 of the Piezometer Completion Information form.

22. Cap Material. Two-character code describing the cap material. Valid codes are listed on page 1 of the Piezometer Completion Information form.

23. Cap Type. A two-character code describing the type of cap used in the installed well. Valid codes are listed on page 2 of the Piezometer Completion Information form.

24. Comments. Any additional information.

BOREHOLE/PIEZOMETER CONSTRUCTION FIELD DATA LOG

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. A four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

3. Field Rep. The name of the field representative.

4. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

5. Driller code. Three-character or four-character code identifying the company responsible for drilling the borehole.

6. Rig Type. Manufacturer and model of rig.

7. Installer Code. Three-character or four-character code identifying the company responsible for installing and completing a piezometer.

8. Completion Date. Date when well was completed in the format DD-MMM-YY (01-JAN-88).

9. Acceptance Code. One-character code assigned by the facility manager.

10. Borehole Summary

    a. Bit Type. The type of bit used.

    b. Hole Diam (In). Diameter of borehole in inches.

    c. End Depth (Ft). Depth from the ground surface to the bottom of the borehole (in feet and tenths of feet).

    d. Fluid Type. Type of fluid used during the drilling phase of piezometer installation.

11. Casing Summary

    a. Casing Type. One-character code describing the type of casing material used. The codes are listed below.

    b. Description. Describes the casing materials used (for example, Schedule 40 PVC) in well construction.

c. Diameter (In). Diameter of casing in inches.

d. End Depth (Ft). Depth (in feet and tenths of feet) from the top of the casing to the bottom of the casing.

12. Well Construction

a. Type Code. One-character code describing the material used for filling the annulus space in borehole.

b. Description. Describes the materials used in piezometer construction (bentonite pellets, for example) to fill the annulus space in borehole.

c. End Depth (Ft). Depth (from the ground surface) where the materials for well construction are placed in the borehole in feet and tenths of feet.

13. Construction Time Log

a. Start Date. The date construction started.

b. Start Time. The time construction started.

c. End Time. The time when construction ended.

14. Well Development. Any further developments during piezometer construction.

15. Comments. Any additional information.

STANDARD OPERATING PROCEDURE 4.8

PIEZOMETER DEVELOPMENT

1. PURPOSE

To remove foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the piezometer.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the method and equipment to be used for developing the piezometer. Collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

Piezometer development removes the fines from the well or aquifer formation near the screen and corrects damage that occurs during drilling. All piezometer installation procedures create a skin on the borehole wall. There are four primary methods for developing piezometers: overpumping, rawhiding, jetting, and surging.

A. Overpumping involves pumping the piezometer down as low as possible and allowing it to refill. The increased velocities created by refilling remove fines. This method is not very effective, because the water flow is in one direction and at relatively low velocities.

B. Rawhiding is a modification of overpumping. After the water is pumped to the surface, it is either allowed to run back into the piezometer through a foot valveless pump or poured back down the well. This method generates two-directional flow and is superior to overpumping.

C. Jetting involves lowering a pipe into the piezometer with a series of water jets on the end. The jets point horizontally. The high-pressure water pumped through the jets flushes fines from the formation and breaks the skin caused by drilling. As with the other methods, fines must occasionally be pumped from the piezometer during development. An external water supply is needed for jetting. External water is introduced into the formation and alters the hydrochemistry. These are two major disadvantages of the jetting method.

D. Surging involves raising and lowering a surge or swab block inside the piezometer. The resulting motion of the water removes the borehole skin and fines from the formation. The fines and water must occasionally be removed from the piezometer with a sand bailer to prevent sand locking of the surge block. The rubber or viton seals on the surge block are the same diameter as the inside of the piezometer or 1/2-inch smaller if surging is conducted inside the screened interval. A 3-ft stroke is typical.

Surging can also be implemented with high-pressure air. A high-pressure air pipe is lowered into the piezometer, and surges of air are introduced. Water may be literally blown out of the top of the piezometer, and water can be pumped out as the air surging progresses. However, air surging can introduce air into the formation (altering the hydrochemistry) and become entrained in the screens (reducing flow rates). Plastic screens can also be damaged if the air surge is too violent.. A specially fabricated air swab can be used to prevent these types of damage.

E. Surging with a vented (pressure-relief) block (Appendix 5.2) and rawhiding are the preferred methods for piezometer development, although no one method is appropriate for all situations.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
2.2	Field Measurements on Ground and Surface Water Samples
3.1	Water Level Measurement
4.5	Piezometer Installation
6.1	Health and Safety Monitoring of Combustible Gas Levels
6.2	Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
6.3	Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

3.2. Preparation

3.2.1 Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all development equipment.

E. Ensure that permission to discharge development water has been obtained or coordinate efforts to purchase appropriate containment vessels for development.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Decontaminate all equipment before developing each piezometer according to SOP 1.6, General Equipment Decontamination.

B. Assemble containers for the temporary storage of water produced during piezometer development. The containers must be structurally sound, compatible with anticipated contaminants, and field manageable.

NOTE: Truck-mounted tanks may be required for this operation.

3.3. Operation

Perform the development as soon as practical after well installation, but no sooner than 48 hrs after grouting is completed. Do not use any dispersing agents, acids, or disinfectants to enhance the development of the piezometer. Do not add water to aid development except under the special conditions defined below. If problems or unusual conditions are encountered, notify the site manager as soon as possible.

A. Assemble the necessary equipment on a plastic sheet outside of the splash range.

B. Record pertinent information in the logbook and on the Piezometer Completion Information form. A copy of this form and instructions for completing the form are provided in SOP 4.5, Piezometer Installation.

C. Open the piezometer and take the air monitoring reading at the top of the casing and in the breathing zone (see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels; SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector; and SOP 6.3, Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector).

D. Measure depth-to-water and the total depth of the piezometer according to SOP 3.1, Water Level Measurement.

E. Develop the piezometer until the piezometer is free of sediment and the appropriate volumes of water have been removed (see E.4. below). Sediment free is loosely defined as 0.01 ml of sediment in a 1000-ml Inhoff cone. If the well is not free of sediment after the appropriate volumes of water have been removed, continue until twice the appropriate volume of water has been removed. Do not exceed twice the volume without consulting the site manager.

1. Note the initial color, clarity, and odor of the water.

2. Measure and record the initial pH, temperature, and specific conductance of the water according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

3. Containerize all water produced by development in contaminated areas or areas suspected of contamination. Clearly label each container with the location ID. Base the determination of an appropriate disposal method on the first round of analytical results from each well.

4. For those wells where the boring was installed <u>without</u> the use of drilling fluid (bentonite mud or water), remove 5 times the standing water volume in the piezometer (well screen and casing plus saturated annulus). Should recharge be so slow that 5 volumes could not be removed in one day or the water is not sediment free after this 5-volume removal, the site manager will select an alternate procedure for verifying that the piezometer is properly developed.

5. For those piezometers that cannot be cleaned of formation fines (clays and silts) resulting in low yields of formation water, small amounts of project-approved potable water should be added to the well bore. Once the majority of fines have been removed from the piezometer, continue development with formation water only. During this process, it is essential that at least 5 times the amount of water injected must be withdrawn from the piezometer to assure that all potable water has been removed from the formation. Do not add water to the piezometer to assist development without prior approval by the site manager.

6. For those piezometers where the boring was installed/enlarged with the use of drilling fluid (bentonite mud or water), remove 5 times the measured amount of total fluids lost while drilling <u>plus</u> 5 times the standing water volume as defined above. Use the same procedure (of adding more water) for cases of slow recharge, discolored water, or water that is not sediment free.

7. Note the final color, clarity, and odor of the water.

8. Measure and record the final pH, temperature, and specific conductance of the water according to SOP 2.2, Field Measurements on Ground and Surface Water Samples.

9. Complete the appropriate data entry requirements on the Piezometer Completion Information form to document well development. A copy of the form and instructions for completing it are in SOP 4.5, Piezometer Installation.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to the presampling conditions as specified in the FSP or WP.

C. Make sure all piezometer locations are properly staked and the location ID is readily visible on the protective casing.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. After the first round of analytical results have been received, determine and implement the appropriate water disposal method.

B. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

C. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

Barcelona, M. J., J. P. Gibb, J. A. Helfrich, and E. E. Garske. 1985. "Practical Guide to Groundwater Sampling." U.S. Environmental Protection Agency report EPA/600/2-85/104. Washington, D.C.: U.S. Government Printing Office.

Gass, Tyler E., "Monitor Well Development." 1986. Water Well Journal 40, no. 1: 52-55.

Schalla, Ronald, and Robert W. Landick. 1986. "A New Valved and Air-Vented Plunger for Developing Small Diameter Monitor Wells," Ground Water Monitoring Review 6, no. 2: 77-80.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Surge Block Schematics

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ pH Meter

_____ Electrical conductivity meter

_____ Distilled water

_____ Stopwatch

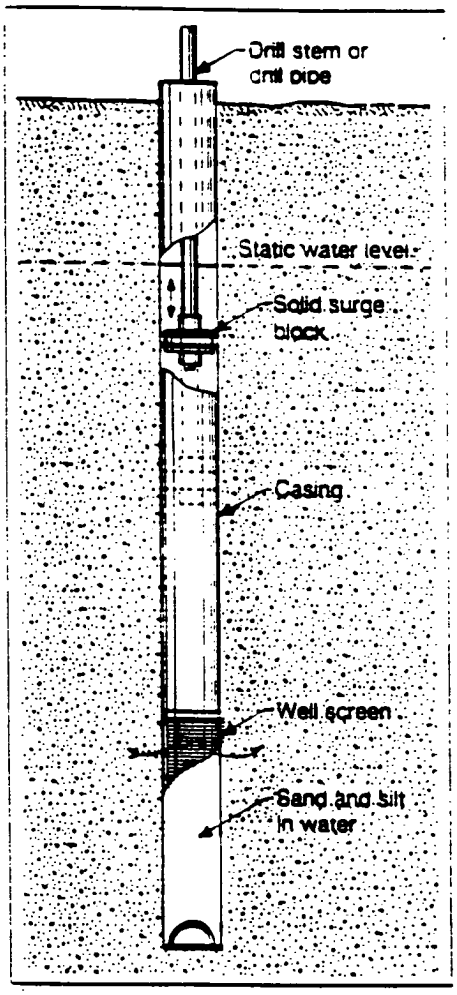
_____ Water level measurement probe

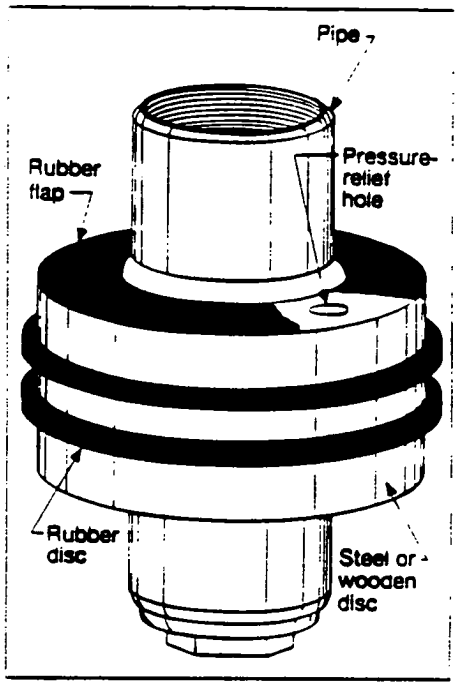
_____ 1000-ml Inhoff cone

_____ Plastic sheet

APPENDIX 5.2

SURGE BLOCK SCHEMATICS





STANDARD OPERATING PROCEDURE 5.1

SOIL AND ROCK BOREHOLE LOGGING AND SAMPLING

1. PURPOSE

To describe the physical nature of consolidated or unconsolidated subsurface earthen materials encountered during auger, rotary, or other drilling activities and collect samples of the earthen materials for further evaluation.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

Before field drilling begins, all management personnel should obtain information about expected geologic and hydrogeologic conditions at the site. The FSP or WP includes directions for sampling methods, location, and details for the site where the field personnel will work.

Most sites where soil and rock borehole logging and sampling are conducted include unconsolidated deposits of varying thickness over consolidated bedrock at depth. Two forms are used for describing the soil and rock encountered during drilling and sampling. The Borehole Log (Soil) form (Appendix 5.2) is used when describing unconsolidated alluvium, colluvium, and regolith. The Borehole Log (Rock) form (Appendix 5.3) is used when drilling or coring rock to describe the lithology and other physical characteristics of sedimentary, igneous, and metamorphic rocks.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information on equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation

1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
4.1	Soil Boring
4.2	Rock Boring

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access. Have areas of subsurface sampling investigated for underground utilities.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

G. Contact the members of the survey crew and inform them of the approximate date that ground surveys will begin.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

B. Record all pertinent information (date, site, ID number, and location) in the logbook or the appropriate data form. Note field conditions, unusual circumstances, and weather conditions.

C. Permanently attach a soil sample identification label to each sample container.

3.3. Operation

3.3.1. Logging Samples

A. Whenever a sample is collected, complete a description of the sample using the Borehole Log (Soil) form (Appendix 5.2) or Borehole Log (Rock) form (Appendix 5.3). Fill out these forms according to the information described in Appendix 5.4. Include all scale drawings that further describe textural variations in the logbook. If cameras are permitted on the site, use photographs instead of drawings.

NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

B. Gross physical properties of the sample can be described by unaided visual observation or inspection under a hand lens. Whenever feasible, prepare sample descriptions by observing fresh surfaces or cuttings.

C. Wash cuttings from mud rotary boring in clear water to remove drilling mud. Use a strainer with a large capacity during the washing process.

D. Split the core lengthwise, so that the interior can be inspected. Place core in cardboard box after inspection. Label top, bottom, and core interval on box. The core box will be lined with plastic to minimize cross-contamination. Mark unrecovered core intervals with blocks of wood. Use two permanent markers of different colors to draw parallel lines on the core so that its proper position in the core box can be maintained during and after future inspections.

E. Record all linear measurements in feet or tenths of feet, not inches.

F. Blow counts are to be counted for each 0.5-ft penetration of the Standard Penetration Test.

G. Use the standard Unified Soil Classification System (USCS) designations for identifying soil strata. Detailed descriptions of the different soil classifications are included in the U.S. Corps of Engineers Technical Memorandum, 1953.

H. Visual descriptions will be according to ASTM Designation D 2488-69 "Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)."

I. Percent core recovery is a measure of coring efficiency and rock quality. If coring progresses gradually, a hard sandstone to a strongly fissile shale, the percent recovery will be affected. Once the core is shown to the field representative (preferably while still in the core barrel if it is a split-core barrel), measure the total length recovered. Sometimes it is possible to determine where core loss occurred in the run. The following clues are sometimes present: plugging off during drilling, intense fracturing in certain sections of core (possibly correlated with rough, high vibrations during drilling), and rolled and recut pieces of core.

J. The rock quality designation (RQD) is based on a modified core recovery procedure and indirectly on the number of fractures and the amount of softening or alteration in the rock mass. Obtain the measure by summing up the total length of core recovered and counting only those relatively hard, sound pieces of core that are four inches in length or longer. See Stags and Zienkiewitz, 1968 for an example of an RQD computation. It is necessary to distinguish between natural fractures and those caused by drilling or recovery operations. Depending on the engineering or hydrogeologic requirements of the project, breaks induced along high anisotropic planes (like foliation or bedding) may be counted as natural fractures. Lengths that contain strong and recemented fractures should be measured in total.

RQD	QUALITY OF ROCK MASS
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
0-25	Very Poor

K. Percent Drilling Fluid Recovery--the volume of fluid losses and the interval over which they occur. For example, no fluid loss means that no fluid was lost except through spillage and filling the hole. Partial fluid loss means that a return was achieved, but the amount of return was significantly less than the amount being pumped. Complete water loss means that no fluid returned to the surface during the pumping operation. A combination of opinions from the field personnel and the driller on this matter will result in the best estimate. Make a crude, relatively effective estimate by placing a calibrated stick in the recirculation pit. Estimate the return flow and volume of the pit at intervals of one-half ft to one ft on the stick. Obtain the pumping rate by measuring elapsed time to withdraw a specified volume from the pit without return. After estimating the return flow, a percentage can be obtained. The return flow can sometimes be crudely measured with a five-gallon bucket.

Record a change in the fluid recovery rates. If the recovery is essentially the same for an entire core run, only one call per change is necessary. Record the change in fluid recovery rate to the nearest 10%.

L. Spacing. Describe the spacing of discontinuities as close or wide according to the following tables.

SPACING	FOLIATION, BANDING, OR BEDDING	SYMBOL
(1) More than 6 ft	Very thickly (bedded or banded)	VT
(2) 2 to 6 ft	Thickly	T
(3) 8 to 24 inches	Medium	M
(4) 2 1/2 to 8 inches	Thinly	TN
(5) 3/4 to 2 1/2 inches	Very thinly	VTN

In describing structural features, describe the rock mass as thickly bedded or thinly bedded according to the above criteria. Depending on the project requirements, identify the form of joint (stepped, smooth, undulating, or planar), its dip (in degrees), its surface (rough, smooth, or slickensided), its opening (giving width), and its filling (none, sand, clay, or breccia).

M. Orientation. The orientation is the angle of bedding, joints, or fractures measured with a clear plastic protractor to the nearest 10°. Reference all measurements with 0° at horizontal. If fractures have a persistent orientation, record at the beginning and repeat every 5 ft in depth.

N. Condition. The texture of the fractures. Examples of condition are smooth, clean, rough, and stained.

O. Weathering. Describe the degree of weathering according to the following table.

GRADE	SYMBOL	DIAGNOSTIC FEATURES
Fresh	F	No visible sign of decomposition or discoloration. Rings under hammer impact present.
Slightly Weathered	SLW	Slight discoloration inward from open fractures; otherwise, similar to fresh.
Moderately Weathered	MW	Discoloration throughout. Weaker minerals (like feldspar) have decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture has been preserved.
Highly Weathered	HW	Most minerals are somewhat decomposed. Specimens can be broken by hand with effort or shaved with a knife. Core stones present in rock mass. Texture becoming indistinct, but fabric has been preserved.

Completely	CW	Minerals decomposed to soil, but fabric and structure have been preserved (saprolite). Easily crumbled or penetrated. Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

CAUTION: Soft rock is not necessarily weathered. Look for alteration minerals that indicate true weathering has occurred.

P. Hardness. Describes the degree of hardness according to the following table.

CLASS	HARDNESS	SYMBOL	FIELD TEST
I	Extremely hard	EH	Many blows with geologic hammer required to break intact specimen.
II	Very hard	VH	Hand-held specimen breaks with hammer end of pick under more than one blow.
III	Hard	H	Cannot be scraped or peeled with knife; hand-held specimen can be broken with single moderate blow with pick.
IV	Soft	SO	Can just be scraped or peeled with knife. Indentations 1 mm to 3 mm show in specimen with moderate blow with pick.
V	Very soft	VSO	Material crumbles under moderate blow with sharp end of pick and can be peeled with a knife, but specimen is too hard to hand trim to a size usable in a triaxial test apparatus.

Q. Lithologic. The type of strata encountered during various subsurface exploratory investigations. The geologic lithology codes that are to be used are listed in Appendix 5.7.

R. Visual Description. Other petrologic descriptors that aid in the classification of the rock or soil. Information that should be included is listed below.

1. Typical Name
   Sandstone, schist, granite, or any of the appropriate names/descriptions included in Appendix 5.6

2. Grain Size
   Fine, medium, or coarse

3. Structure
   Stratified, laminated (varved), fissured, slickensided, blocky, lensed, or homogeneous (nonstratified)

4. Color
   Use A.S.A. rock color chart for rocks; use Mansell color chart for soils. This should include grey colors for reduced soils.

5. Cementation
   Weak or strong

6. Local or Geologic Name

7. Group Symbol from Appendix 5.5 or 5.6

S. Place samples for analyses in appropriate containers (see SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples). Designate sample intervals removed from core by wooden blocks that have been properly labeled according to the interval sampled.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and plug open sampling holes, as specified in the FSP or WP.

C. Make sure all borehole locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial and date all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are understood.

4. SOURCES

ASTM. 1986. "Standard Method for Penetration Test and Split-Barrel Sampling of Soils," 298-303, ASTM D: 1586-84. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Practice for Thin-Walled Tube Sampling of Soils," 304-307, ASTM D: 1587-83. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Practice for Diamond Core Drilling For Site Investigation," 333-337, ASTM D: 2113-83. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Test Method for Classification Of Soils For Engineering Purposes," 397-410, ASTM D: 2487-85. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)," 411-25, ASTM D:2488-84. American Society of Testing Methods, Philadelphia, Pennsylvania.

ASTM. 1986. "Standard Practice for Ring-Lined Barrel Sampling of Soils," 560-563, ASTM D: 3550-84. American Society of Testing Methods, Philadelphia, Pennsylvania.

U.S. Corps of Engineers. 1953. "The Unified Soil Classification System." Technical Memorandum No. 3-357. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Borehole Log (Soil) Form

5.3. Borehole Log (Rock) Form

5.4. Data Form Completion

5.5. Checklist for Description of Fine-Grained Soils

5.6. Checklist for Description of Coarse-Grained Soils

5.7. Geologic Lithology Codes

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Plastic sheet

_____ Hand lens

_____ Tape measure (divided by feet and tenths of feet)

_____ Wooden blocks (for core)

_____ Core boxes

_____ Grain-size chart

_____ Color chart

_____ Dilute HCl

_____ Red and blue permanent markers

_____ Strainer

_____ Sample labels

_____ Sample containers

APPENDIX 5.2

BOREHOLE LOG (SOIL) FORM

BOREHOLE LOG (SOIL)

PAGE 1 OF ____

FACILITY CODE _____ **DRILLER CODE** _____
LOCATION ID _____ **COMPLETION DATE** _____
COORDINATES (FT): **DIAMETER (IN)** _____
NORTH _____ **EAST** _____ **DEPTH (FTFD)** _____
GROUND ELEVATION (FT MSL) _____ **CONSTRUCTION METHOD** _____
LOCATION TYPE BH _____ **ACCEPTANCE CODE** _____
COMMENTS _____

GROUNDWATER LEVELS

DATE	TIME	DEPTH (FT)

LOCATION DESCRIPTION

_____

LITHOLOGIC LOG

LOGGER CODE _____

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	SAMPLE METHOD	SAMPLE ID	BLOW COUNT (PER 6 IN)	N VALUE	USCS	VISUAL DESCRIPTION

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

CONSTRUCTION METHODS:

A – AIR ROTARY
B – BORED OR AUGERED
C – CABLE–TOOL
D – DUG
H – HYDRAULIC–ROTARY
J – JETTED
P – AIR–PERCUSSION
R – REVERSE ROTARY
T – TRENCHING
V – DRIVEN
W – DRIVE AND WASH
Z – OTHER (SPECIFY)

SAMPLE METHODS:

A – AUGER CUTTINGS
S – 2" O.D. 1.38" I.D. DRIVE SAMPLE
U – 3" O.D. 2.42" I.D. TUBE SAMPLE
T – 3" O.D. THIN–WALLED SHELBY TUBE
O – OTHER (SPECIFY)

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
BHD–002 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

BOREHOLE LOG (SOIL)

PAGE ____ OF ____

FACILITY CODE _____

LOCATION ID _____ **COMPLETION DATE** _____

LITHOLOGIC LOG

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	SAMPLE METHOD	SAMPLE ID	BLOW COUNT (PER 6 IN)	**N VALUE**	**USCS**	**VISUAL DESCRIPTION**

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
SHD-002 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

BOREHOLE LOG (ROCK) FORM

BOREHOLE LOG (ROCK)

PAGE 1 OF ____

FACILITY CODE _____ **DRILLER CODE** _____
LOCATION ID _____ **COMPLETION DATE** _____
COORDINATES (FT): **DIAMETER (IN)** _____
NORTH _____ **EAST** _____ **DEPTH (FTFD)** _____
GROUND ELEVATION (FT MSL) _____ CONSTRUCTION METHOD _____
LOCATION TYPE BH _____ **ACCEPTANCE CODE** _____

GROUNDWATER LEVELS

DATE	TIME	DEPTH (FT)

LOCATION DESCRIPTION

_____
_____
_____
_____
_____

LITHOLOGIC LOG

LOGGER CODE _____

DEPTH (FT)	PACKER TEST INTERVAL	DRILLING METHOD	SAMPLE ID	% CORE RECOVERY	% ROCK QUALITY DESIGNATION (RQD)	% DRILLING FLUID RECOVERY	SPACING	ORIENTATION	CONDITION	WEATHERING	HARDNESS	LITHOLOGIC	**VISUAL DESCRIPTION**

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

CONSTRUCTION METHODS:

A – AIR ROTARY
B – BORED OR AUGERED
C – CABLE-TOOL
D – DUG
H – HYDRAULIC-ROTARY
J – JETTED
P – AIR-PERCUSSION
R – REVERSE ROTARY
T – TRENCHING
V – DRIVEN
W – DRIVE AND WASH
O – OTHER (SPECIFY)

DRILLING METHODS:

H – 6 1/2" HOLLOW STEM AUGER
C – 4 1/2" CONTINUOUS FLIGHT AUGER
GB – GEAR BIT
NX – NX ROCK CORING
NQ – NQ WIRELINE ROCK CORING

SPACING:

BEDDED, FOLIATION, ETC:
VT – VERY THICKLY
T – THICKLY
M – MEDIUM
TN – THINLY
VTN – VERY THINLY

JOINTS/FAULTS:
VW – VERY WIDELY
W – WIDELY
M – MEDIUM
C – CLOSELY
VC – VERY CLOSELY

CONDITION:

ND – NODULAR
MT – MOTTLED
V V – VARVED
BN – BANDED
ST – STINGERS
SM – SMOOTH
CL – CLEAN
RH – ROUGH
SL – SLIGHT

WEATHERING:

F – FRESH
SL – SLIGHTLY WEATHERED
MW – MODERATLY WEATHERED
HW – HIGHLY WEATHERED
CW – COMPLETELY WEATHERED
RS – RESIDUAL SOIL

HARDNESS:

EH – EXTREMELY HARD
VH – VERY HARD
H – HARD
S – SOFT
VS – VERY SOFT

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
BHO–003 (3/88)

_____ FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE

BOREHOLE LOG (ROCK)

PAGE ____ OF ____

FACILITY CODE _____

LOCATION ID _____ COMPLETION DATE _____

LITHOLOGIC LOG

DEPTH (FT)	PACKER TEST INTERVAL	DRILLING METHOD	SAMPLE ID	% CORE RECOVERY	% ROCK QUALITY DESIGNATION (RQD)	% DRILLING FLUID RECOVERY	SPACING	ORIENTATION	CONDITION	WEATHERING	HARDNESS	LITHOLOGIC	VISUAL DESCRIPTION

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

BHD-003 (1/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.4

DATA FORM COMPLETION INSTRUCTIONS

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

BOREHOLE LOG (SOIL) FORM AND BOREHOLE LOG (ROCK) FORM

The following information explains the completion of the upper portion of both forms.

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where chemical, biological, radiological, and other measurements are taken.

3. Coordinates (Ft): North/East. The horizontal location of the borehole. At the time of the field investigation, the exact coordinate position of the borehole will not be known. In this case, write NA in the two spaces on the form. This information will be provided on an addendum form when the survey data comes in after the drilling program has been completed.

4. Ground Elevation. At the time of the field investigation, the exact ground elevation of the borehole will not be known. In this case, write NA in the space on the form. This information will be provided on an addendum to the original data form when the survey data comes in after the drilling program has been completed.

5. Location Type BH is a standard location type for a borehole log or well.

6. Driller Code. A maximum of four characters noting the company responsible for drilling.

7. Completion Date. The date when the borehole reached total depth in the format DD-MMM-YY (01-JAN-88).

8. Diameter. Diameter of borehole in inches and tenths of inches.

9. Depth. Total depth of borehole in feet and tenths of feet.

10. Construction Method. The construction or drilling method used in the advancement of the borehole. A table of various construction methods is included at the bottom of each Borehole Log form.

11. Acceptance Code. A one-character code assigned by the facility manager.

12. Groundwater Levels. Record depth-to-water when encountered during the drilling. Take at least one water level measurement after the completion of drilling and the borehole has been left open or a piezometer or monitoring well has been installed. Before taking water level measurements, see SOP 3.1, Water Level Measurement.

13. Location Description. Description of the approximate borehole location in respect to some recognizable, permanent topographic or geographic location that is nearby.

14. Logger Code. Four-character code identifying the company responsible for collecting the information recorded on the form.

15. Depth in Feet That Depicts Lithologic or Soil Boundaries. Record depths on the Borehole Logs in feet and fractions (tenths of feet).

Conversion Table

Inches to Tenths of Feet

Inches	Tenths of Feet
1	.08
2	.17
3	.25
4	.33
5	.42
6	.50
7	.58
8	.67
9	.75
10	.83
11	.92
12	1.00

16. Sample ID. Four-digit number assigned to ensure that data collected retains uniqueness from other data collected at the same location ID.

A. The following describes the nonrepetitive information required for completing the Borehole Log (Soil) form.

1. Comments. Includes preservation method and any additional information.

2. Sample Interval. The designated starting and ending depth of the appropriate sampling technique. The following table summarizes common intervals for sample lengths.

APPENDIX 5.4, Continued

Sampling Device	Sample Interval (Feet)	Example Depth Internal
SPT	1.5 or 2.0	14.8 - 16.3
Large-diameter ring sample	1.0, 1.5, or 2.0	14.8 - 15.8
Shelby tube	2.0	14.8 - 16.8
Continuous sampler	5.0	14.8 - 19.8

If the designated sample is 1.5 ft standard penetration test (SPT), but in actuality the SPT only penetrates 0.5 ft (or some length less than the sample interval) in 50 blows per 6 inches or less (refusal blow count), the graphical representation for the sample interval remains at 1.5 ft.

3. Sample Recovery. The numerical representation of the actual sample recovered by the respective sampling method.

4. Sample Retained. The numerical representation of the actual sample retained for future laboratory testing. This number cannot be larger than the sample recovery number. If no sample is recovered, write NR for no recovery in the space provided.

5. Sample Method. One-character code to identify the sampling method used to retain a subsurface soil sample. Sample types are listed below. The box in the lower right-hand corner of the Borehole Log (Soil) form lists the types of samples.

   Sample Types:

   A Auger cuttings
   S 2-inch O.D., 1.38-inch I.D. drive sample
   U 3-inch O.D., 2.42-inch I.D. tube sample
   T 3-inch O.D., thin-walled Shelby tube
   O Other (specify)

6. Blow Count. The number of blows (blow counts) required for every 6 inches of the 18-inch or 24-inch SPT.

7. N Value. The sum of the number of blows in the last two 6-inch intervals of the SPT.

8. Unified Soil Classification System (USCS). Two-character code describing soil strata encountered during drilling. Use the standard Unified Soil Classification (USCS) designations except when a combination of two soils is encountered. In that case, use two different two-character codes (separated by a dash, like CL--ML). Codes may also be derived from the agricultural classifications of

soils. Agricultural classifications are not standard and vary from region to region for the same basic soil type.

For the purpose of classifications, the USCS system recognizes 15 soil groups, each having distinctive engineering properties. A listing of these 15 USCS classifications is shown below.

CH	Fat Clays
CL	Lean Clays, Sandy Clays, or Gravelly Clays
GC	Clayey Gravel or Clayey Sandy Gravel
GM	Silty Gravel or Silty Gravelly Sand
GP	Gravel or Sandy Gravel--Poorly Graded
GW	Gravel or Sandy Gravel--Well Graded
MH	Micaceous Silts or Diatomaceous Soils
OH	Fat Organic Clays
OL	Organic Silts or Lean Organic Clays
PT	Peat, Humus, and Other Organic Swamp Materials
SC	Clayey Sand or Clayey Gravelly Sand
SM	Silty Sand or Silty Gravelly Sand
SP	Sand or Gravelly Sand--Poorly Graded
SW	Sand or Gravelly Sand--Well Graded

9. Visual Description. The soil description will be according to the ASTM Designation, D 2488-69 Standard Recommended Practice for Description of Soils (Visual-Manual Procedure). Appendixes 5.5 and 5.6 include checklists outlining minimum descriptions of fine-grained and coarse-grained soils.

B. The following describes the nonrepetitive information required to complete the Borehole Log (Rock) form.

1. Packer Test Interval. A graphical representation that denotes the bottom of the top packer and the top of the bottom packer by a solid line drawn in the column.

2. Drilling Method. The drilling method could be, but is not limited to, gear bit, NX rock coring, or NQ wireline rock coring. The box in the lower right-hand corner of the Borehole Log (Rock) form lists the accepted abbreviations for drilling methods shown below.

<u>Drilling Methods</u>

GB	Gearbit (specify diameter)
NX	NX Rock Coring
NQ	NQ Wireline Rock Coring
AR	Air Rotary
MR	Mud Rotary
WR	Water Rotary
CT	Cable Tool

3. Percent Core Recovery. The total length of the recovered core multiplied by 100 and divided by the length of the core run results in the percentage of recovery. Record the recovery of core to the nearest 5%.

4. Rock Quality Designation (RQD). The Rock Quality Designation (RQD) is computed by summing the lengths of all pieces of core equal to or longer than 4 inches and dividing by the percent recovery. The result is multiplied by 10 to yield the RQD in a percentage form that can be recorded to the nearest 5%.

$$RQD = \frac{\text{Sum of Length} > 4 \text{ inches}}{\text{Total Length of Core}}$$

5. Percent Drilling Fluid Recovery. After estimating the return flow, a percentage can be obtained. Record a change in the fluid recovery rates. If the recovery is essentially the same for the entire core run, only one call per change is necessary. Record it to the nearest 10%.

6. Spacing. Describe the spacing of discontinuities with the symbols or verbiage described in section 3.3.1.M.

7. Orientation. Record this call to the nearest 10°.

8. Condition. Examples of conditions are smooth, clean, rough, or stained.

9. Weathering. Describes as fresh the degree of weathering (slight, moderate, or high), complete, or residual soil.

10. Hardness. Describes sample as extremely hard, very hard, hard, soft, or very soft.

11. Lithologic. Two-character code describing the lithology encountered during various subsurface exploratory investigations. Use the geologic lithology codes listed in Appendix 5.7.

12. Visual Description. Other petrologic descriptors to assist in the classification of the rock.

APPENDIX 5.5

CHECKLIST FOR DESCRIPTION OF FINE-GRAINED SOILS

1. Typical Name

   Sandy silt, silt, clayey silt, sandy clay, silty clay, clay, organic silt, organic clay, or fill

2. Size Distribution

   Approximate percent gravel, sand, and fines in fractions finer than three inches

3. Color

   Note presence of mottling and banding, as well as soil color

4. Moisture Content

   Dry, moist, wet, or saturated

5. Consistency

   Soft, firm (medium), stiff, very stiff, or hard

6. Structure

   Stratified, laminated (varved), fissured, blocky, lensed, or homogeneous (nonstratified)

7. Cementation

   Weak, strong, or absent

8. Local or Geologic Name

9. Group Symbol

   U.S.C.S. Soil Classification

Group Symbol	Group Name
CL	Lean clay (low to medium plasticity)
ML	Silt
OL	Organic clay or silt (lean)
CH	Fat clay (high plasticity)
MH	Elastic silt
OH	Organic clay or silt (fat)
PT	Peat

APPENDIX 5.6

CHECKLIST FOR DESCRIPTION OF COARSE-GRAINED SOILS

1. Typical Name

   Sand, clayey sand, silty sand, gravel, clayey gravel, silty gravel, cobbles, or boulders

2. Gradation

   Well graded (uniformly graded) or poorly graded (gap-graded)

3. Size Distribution

   Approximate percent gravel, sand, and fines in fractions finer than three inches.

4. Grain Shape

   Angular, subangular, subrounded, or rounded

5. Color

6. Moisture Content

   Dry, moist, wet, or saturated

7. Structure

   Stratified, lensed, or nonstratified

8. Cementation

   Weak or strong

9. Local or Geologic Name

10. Group Symbol

    U.S.C.S. Soil Classification

Group Symbol	Group Name
GW	Well-graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well-graded sands
SP	Poorly graded sands
SM	Silty sand
SC	Clayey sand

APPENDIX 5.7

GEOLOGIC LITHOLOGY CODES

LITHOLOGIC	NAME/DESCRIPTION
AL	Alluvium
BA	Basalt
BR	Undifferentiated Bedrock
BT	Bandelier Tuff
CG	Conglomerate
CH	Fat Clays
CL	Lean Clays, Sandy or Silty Clays, or Gravelly Clays
CA	Calcrete
CR	Chert
CS	Claystone
DI	Diorite
DO	Dolomite
FL	Fill Material
GC	Clayey Gravel or Clayey Sandy Gravel Soils
GM	Silty Gravel or Silty Soils
GN	Gneiss
GP	Gravel or Sandy Gravel, Poorly Graded
GR	Granite
GW	Gravel or Sandy Gravel, Well Graded
GY	Gypsum
LG	Lignite
LS	Limestone
MH	Micaceous Silts or Diatomaceous Soils
ML	Silts, Sands, or Clayey Fine Sands
NR	No Recovery of Data For Classifying
OH	Organic Clays of High Plasticity
OL	Organic Silts or Organic Clays of Low Plasticity
OT	Other General Materials
PT	Peat, Humus, and Other Organic Swamp Soils
QT	Quartzite
RY	Rhyolite
SA	Salt
SC	Clayey Sand or Sand-Clay Mixture
SH	Shale
SI	Silcrete, Poorly Graded
SM	Silty Sand or Sand-Silt Mixtures
SP	Sand or Gravelly Sand, Poorly Graded
SS	Sandstone
ST	Siltstone
SW	Sand or Gravelly Sand, Well Graded
TF	Tuff
TI	Till
TP	Unknown
TS	Topsoil, Undifferentiated
VO	Volcanics

STANDARD OPERATING PROCEDURE 5.2

SOIL SAMPLING WITH A SPADE AND SCOOP

1. PURPOSE

To describe a method for collecting a grab soil sample less than 4 ft below the land surface.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

Sampling of the soil horizons above the groundwater table can detect contaminants before they migrate into the water table. Soil sample analysis can assist in determining the extent of the contaminant source term and establish the amount of contamination absorbed into aquifer solids that have the potential to contaminate groundwater.

Accurate, representative samples can be collected with this procedure, if care and precision are demonstrated by the technician. The spade-and-scoop method can be used in most soil types, but is somewhat limited to sampling near the soil surface. Sample collection from depths greater than 4 ft can become extremely labor-intensive. Collection of samples from near the soil surface can be accomplished with tools like spades, shovels, and scoops. Spades and shovels will be used to remove surficial material to the required depth. Then a stainless steel or Teflon scoop is used to collect the sample. Devices plated with chrome or other materials are not acceptable for sample collection. The use of a flat, pointed mason trowel often aids in collecting undisturbed soil profile samples. To the extent possible, the sampling process should not alter the medium being investigated. In general, samples should be kept at 4°C, protected from direct light, sealed tightly in glass bottles, and analyzed as soon as possible.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation

1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
5.1	Soil and Rock Borehole Logging and Sampling

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access. Have areas of subsurface sampling investigated for underground utilities.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and FSP or WP).

3.3. Operation

A. Whenever a sample is collected, complete a description of the sample using the Borehole Log (Soil) form. Copies of this form and instructions for completing the form are supplied in SOP 5.1, Soil and Rock Borehole Logging and Sampling.

B. Procedure for Soil Sampling

1. Carefully remove the top layer of soil to the desired sample depth with a spade which has been appropriately decontaminated.

2. Using an appropriate decontaminated stainless steel or Teflon scoop or trowel, remove and discard a thin layer of soil from the area that comes in contact with the shovel.

3. Transfer the sample into an appropriate sample bottle with a stainless steel or Teflon scoop, lab spoon, or equivalent.

4. If required, be sure the Teflon liner is present in the cap. Secure the cap tightly. Preservation with chemical additives is not necessary; it is achieved by cooling the sample with ice to 4°C. If feasible, minimize holding time and transport the sample to the laboratory no later than two days after collection.

5. Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories of parameters.

   NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

6. Decontaminate equipment between sample locations according to SOP 1.6, General Equipment Decontamination.

7. Fill the hole and replace any grass turf.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record pertinent sample location information in the logbook.

B. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

C. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

D. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that the samples arrived safely and the instructions for sample analyses are clearly understood.

4. SOURCE

Ford, Patrick J., Paul J. Turina, and Douglas E. Seely. 1984. Available Sampling Methods, 2d ed. Vol. 2, Characterization of Hazardous Waste Sites - A Methods Manual. U.S. Environmental Protection Agency document EPA/600/4-84/076. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIX

5.1. Equipment and Supplies Checklist

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stainless steel scoop or lab spoon (scoopulas)

_____ Stainless steel shovel or flat-pointed mason trowel

_____ Stainless steel spade

_____ Tape measure (tenths of feet)

_____ Teflon sheets or stainless steel sampling trays

_____ Plastic Sheet

_____ Alconox

_____ Brushes (long handle, scrub, and wire)

_____ Galvanized tub

_____ Trash bags

_____ Buckets (galvanized, stainless steel, and plastic)

_____ Garden pressure sprayer

_____ Cleaning wipes

_____ Kim wipes

_____ Storage containers for waste decontamination solutions

_____ Blue Ice or equivalent

_____ Disposable laboratory gloves

_____ Camera and film

_____ Sample containers and preservatives

_____ Any additional supplies listed in associated procedures, as needed

STANDARD OPERATING PROCEDURE 5.3

SUBSURFACE SOLID SAMPLING WITH HAND AUGER AND THIN-WALL SAMPLER

1. PURPOSE

To define a method of collecting grab subsurface solid samples with a hand auger and thin-wall tube sampler.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

Solid samples can be recovered directly with a hand auger or with a thin-wall tube sampler. The thin-wall tube sampler provides a less disturbed sample than that obtained with a hand auger. However, it may not be possible to force the thin-wall tube sampler through some soil, and sampling with the hand auger may be the most viable alternative. It is usually not practical to use the hand auger or thin-wall sampler at depths beyond 20 ft.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain information on the performance of field activities. They should be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a lobgook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Document field conditions, unusual circumstances, and weather in the logbook.

3.2.3. Field

Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. Operation

This method uses an auger, a series of rods, a T handle, and a thin-wall tube or split-spoon sampler (Appendix 5.2). Bore a hole to a desired sampling depth (up to 20 ft) with the auger and then withdraw it. Replace the auger tip with a tube core (sampler), lower it down the borehole, and drive the auger into the soil at the completion depth. Withdraw the core and collect the sample.

Three types of augers are available for this method of sampling. They are bucket-type, continuous flight (screw), and posthole augers. The bucket-type auger is more appropriate for direct sample recovery. The bucket-type auger is fast and provides a large volume of sample. When a continuous flight auger is used, the sample can be collected directly off the flights that are usually in 5-ft intervals.

The continuous flight auger is satisfactory for use when a composite of the complete soil column is desired. Posthole augers have limited utility for sample collection because they are designed to cut through fibrous, rooted swampy areas. In soil where the borehole will not remain open when the tool is removed, use a temporary casing until the desired sampling depth is reached.

3.3.1 Collection of Samples

A. Clear any surface debris (twigs, rocks, and litter) from the area to be sampled. It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.

B. Begin augering, periodically removing accumulated soils. This prevents accidentally brushing loose material back down the borehole when removing the auger or adding drill rods.

C. After reaching the desired depth, slowly and carefully remove the auger from boring.

   NOTE: When sampling directly from the auger, collect the sample after the auger is removed from boring and proceed to step I.

D. Remove auger tip from drill rods and replace with a precleaned, thin-wall tube sampler. Install the proper cutting tip.

E. Lower the tube sampler down the borehole, being careful not to scrape soil from the sides of the borehole that will fall into the bottom of the borehole. Gradually force the tube sampler into the soil. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring because the vibrations may cause the boring walls to collapse.

F. Remove the tube sampler and unscrew the drill rods.

G. Remove the cutting tip and remove the core from the device.

H. Discard all disturbed soil from the top of the core (usually at least the top one inch, which represents any material collected by the tube sampler before penetration of the layer in question).

I. Place sample into an appropriate container.

   NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains copies of the form and label and instructions for completing the form and label.

J. Be sure a Teflon liner is present in the cap. Secure the cap tightly onto the sample container. Preserve the sample container with ice or in a refrigerator. Freezing may be required (for instance, Hg or tritium determinations). Consult SOP 1.5, Guide To Handling,

Packaging, and Shipping of Samples, and SOP 1.4, Sample Containers and Preservation.

K. If another sample is to be collected at a greater depth in the same hole, reattach the auger bit to the drill and assembly and follow steps 3-11.

L. Refill the hole and restore the sampling area according to instructions provided in the FSP or WP.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

deVera, E. R., B. P. Simmons, R. D. Stephens, and D. L. Storm. 1980. "Samplers and Sampling Procedures for Hazardous Waste Streams." U.S. Environmental Protection Agency report EPA 600/2-80-018, January 1980. Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Augers and Thin-Wall Tube Sampler

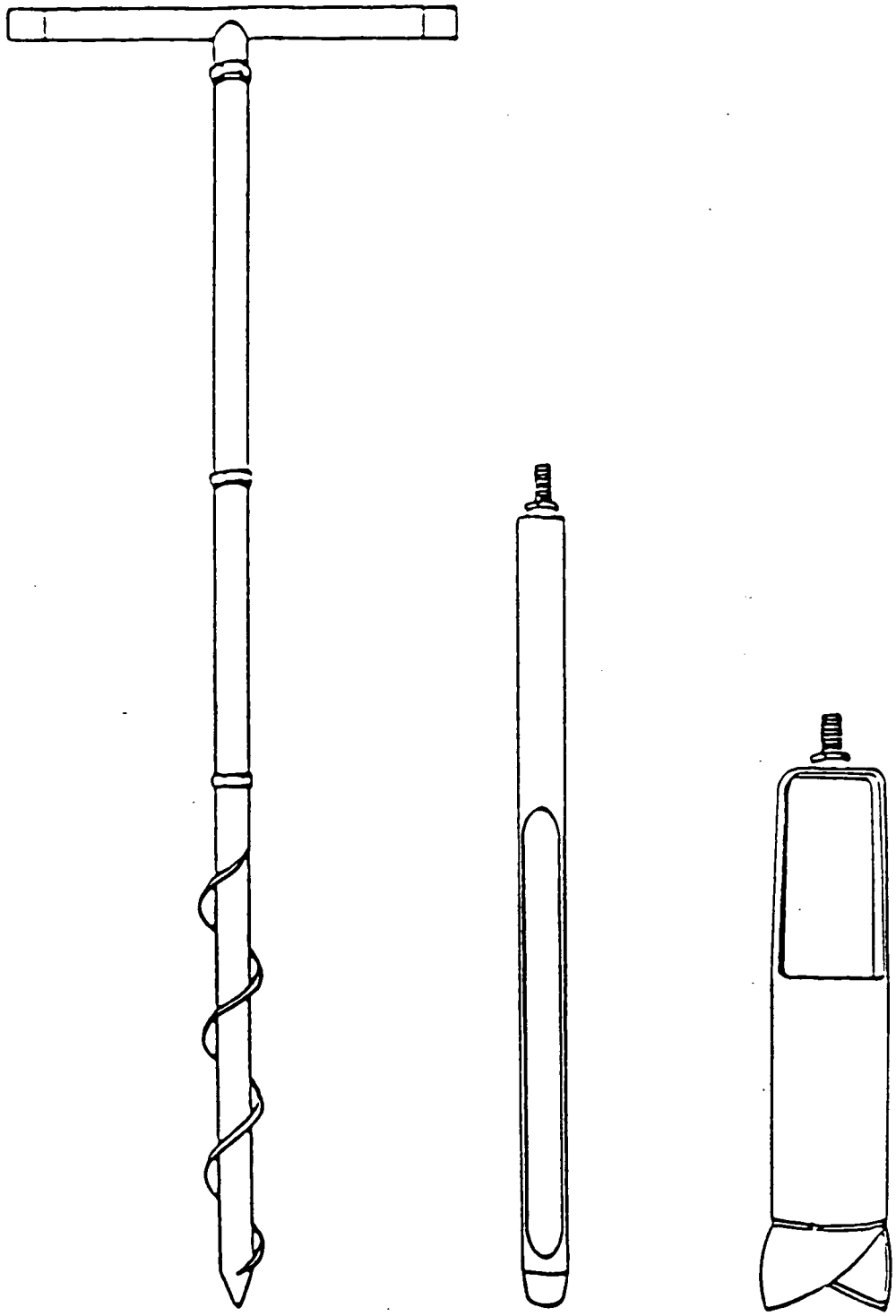
APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

- _____ Thin-wall tube sampler
- _____ Drill rods
- _____ T handle
- _____ Auger
  - _____ Bucket type
  - _____ Continuous flight
  - _____ Posthole
- _____ Sample container(s)
- _____ Decontamination equipment
  - _____ Alconox
  - _____ Sprayer
  - _____ Distilled water
  - _____ Scrub brush
  - _____ Methanol
  - _____ Disposable laboratory gloves
- _____ Combustible gas indicator
- _____ Portable photoionization detector (PID) or flame ionization detector (FID)
- _____ Blue Ice or equivalent
- _____ Plastic sheet
- _____ Any additional supplies listed in associated procedures, as needed

APPENDIX 5.2

AUGERS AND THIN-WALL TUBE SAMPLER



STANDARD OPERATING PROCEDURE 5.8

SOIL SAMPLING WITH A STAINLESS STEEL SURFACE SOIL SAMPLER

1. PURPOSE

To define procedures for collecting surface soil samples to determine the chemical and physical soil properties.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) contains specific details about the procedures and equipment for this SOP. Refer to the FSP or WP for the type of samples to be collected. Collection and measurement of samples and the documentation of data will be performed as described in the associated procedures.

Sampling of the soil horizons above the groundwater table can detect contaminants before they migrate into the water table. Soil-sample analysis can help determine the extent of the contamination and establish the amount of contamination sorbed on aquifer solids that have the potential to contaminate groundwater. However, the depth from which soils are collected and the properties of the sampling tool can result in a high variability of soil chemical/physical properties. To optimize accuracy and precision in measuring soil chemical/physical properties, collect surface soil samples at a uniform depth and volume.

To reduce error introduced by field techniques, collect soil samples in a consistent manner and use chemically inert sampling materials. The sampler must be constructed of machined stainless steel and include a beveled cutting edge at one end of the sample collection ring. The capacity of the ring may vary, depending on the laboratory test for the collected sample. Typically, the ring sampler is from 3 to 4 inches in diameter and 2 to 8 inches in length. The ring sampler can be constructed of thin walls, as long as it is capable of withstanding the force of being driven into the ground by a 10-lb drop-hammer extension without deforming.

Soil types can vary considerably at a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. Therefore, it is important that a detailed record is maintained during sampling operations, particularly regarding location, depth, and other characteristics (grain size, color, odor, and readings obtained from field-monitoring equipment) specified in the FSP or WP. Changes in temperature, available oxygen, and light penetration can radically alter the rate of chemical reactions or the associated microbial activity in a sample. As a result, samples should be kept at their at-depth temperature or lower and protected from direct light. They should be sealed tightly in glass bottles and analyzed as soon as possible.

3. PROCEDURES

3.1. Associated Procedures

Before every operation, a review of the SOPs 1.1-1.10 is necessary. These SOPs contain general information on the performance of field activities. They should

be consulted for specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.3	Sample Control and Documentation
1.4	Sample Containers and Preservation
1.5	Guide to Handling, Packaging, and Shipping of Samples
1.6	General Equipment Decontamination
4.1	Soil Boring
5.1	Soil and Rock Borehole Logging and Sampling

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all sampling equipment.

E. Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.

F. Contact the carrier that will transport samples to obtain information on regulations and specifications.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. When necessary, decontaminate or preclean all equipment before soil sampling as described in SOP 1.6, General Equipment Decontamination.

B. Decontaminate all sampling equipment before taking the first sample and between sampling intervals (see SOP 1.6, General Equipment Decontamination, and the FSP or WP).

3.3. **Operation**

A. Whenever a sample is collected, describe the location and sample using the Location Information and Borehole Log (Soil) forms. Copies of these forms are supplied in SOP 4.1, Soil Boring, and SOP 5.1, Soil and Rock Borehole Logging and Sampling, respectively. Complete the forms as described in these SOPs.

B. Procedure for Soil Sampling

NOTE: The component parts of a typical surface soil sampler are illustrated in Appendix 5.2.

1. Place the sampling cap inside the sampler ring and drive the assembly into the ground with a weighted drive hammer. Drive the sampler ring into the ground until the inside bottom of the cap touches the soil surface, but no further.

2. Use a stainless steel trowel with the same diameter as the sampler ring to move excess soil from the sides of the ring sampler. Push the trowel underneath the ring sampler, keeping the trowel in contact with the ring walls.

3. Raise and invert the sampler assembly, keeping the trowel in place.

4. If physical properties of the soil are to be determined, transport the sampler ring directly to the laboratory for *in situ* measurements of the undisturbed sample.

   If soil chemistry properties are to be determined, remove the soil from the ring sampler and transfer the sample into an appropriate sample bottle with a stainless steel or Teflon scoop, lab spoon, or the equivalent. Consult SOP 1.4, Sample Containers and Preservation, for guidance regarding the type of sample container, holding time, and preservation techniques to be used. If required, be sure the Teflon liner is present in the cap. Secure the cap tightly. Preservation with chemical additives is not necessary. Instead, preservation techniques are limited to cooling the sample with ice. When feasible, minimize the holding time. Transport the sample to the laboratory no later than two days after collection.

   NOTE: Whenever a sample is collected, a custody record must be initiated on the Custody Transfer Record/Lab Work Request form and a Soil Sample Identification Label affixed to the sample container. SOP 1.3, Sample Control and Documentation, contains

copies of the form and label and instructions for completing the form and label.

5. Clean the sampler assembly with a wire brush and decontaminate the equipment according to SOP 1.6, General Equipment Decontamination, between sample locations.

6. Fill the hole and replace any grass turf.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. Restore the site to presampling conditions and fill open sampling holes as specified in the FSP or WP.

C. Make sure all sampling locations are properly staked and the location ID is readily visible on the location stake.

D. Prepare samples and transport according to SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples.

3.4.2. Documentation

A. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the site manager for technical review. He/she will review, sign forms, and transmit to the document control officer (copies to the files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

C. Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

4. SOURCE

Soiltest Environmental Division. 1986. "Test Instrumentation and Equipment." Soiltest Environmental Division report, Evanston, Illinois.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Component Parts of a Surface Soil Ring Sampler

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Stainless steel ring sampler

_____ Stainless steel trowel

_____ Stainless steel sampler top

_____ Stainless steel wire brush

_____ Drive hammer (3 lbs or 10 lbs)

_____ Plastic sheets or stainless steel sampling trays

_____ Decontamination solutions and distilled water

_____ Brushes (long-handled scrub or wire)

_____ Galvanized tub

_____ Trash bags

_____ Buckets (galvanized, stainless steel, and plastic)

_____ Garden pressure sprayer

_____ Cleaning wipes

_____ Kim wipes

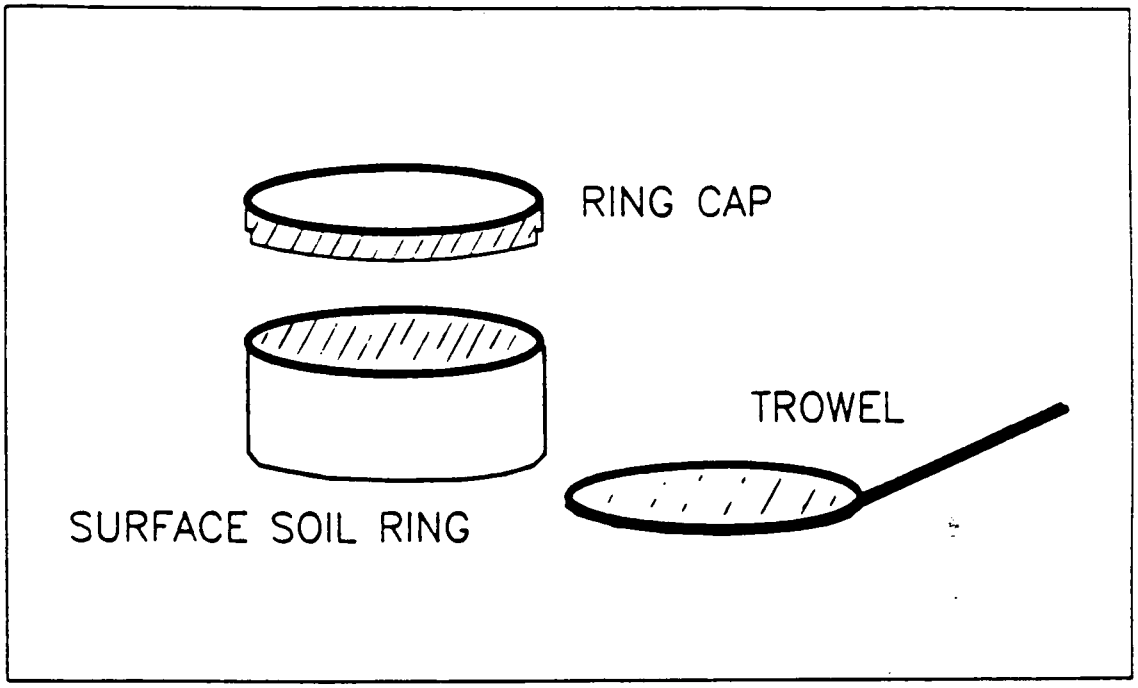
_____ 55-gallon drums

_____ Teflon or stainless steel scoop or spoon

_____ Any additional supplies listed in associated procedures

APPENDIX 5.2

COMPONENT PARTS OF A SURFACE SOIL RING SAMPLER



STANDARD OPERATING PROCEDURE 6.1

HEALTH AND SAFETY MONITORING OF COMBUSTIBLE GAS LEVELS

1. PURPOSE

To describe the equipment and proper method for monitoring combustible gas levels in order to determine when an explosion hazard exists in the work environment.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of specific operations, related health and safety requirements, and the applicability of this procedure. Combustible gas indicators (or explosimeters) are used to determine the potential for the combustion or explosion of unknown atmospheres. A typical combustible gas indicator (CGI) determines the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (LEL) or lower flammability limit (LFL) by measuring the change in electrical resistance in a Wheatstone bridge circuit.

CGIs provide readouts in units of percent LEL, in parts per million (ppm) combustible gases by volume, or both. The types of combustible gases to be encountered are often unknown. In those instances, the more explosive the calibration gas (the lower the LEL), the more sensitive the indication of explosivity, and a greater margin of safety results. The operator should be familiar with the LEL concentrations for specific gases to effectively use instruments that provide data only in ppm combustible gas (by volume).

Although instruments can be purchased that are factory-calibrated for gases like butane, pentane, natural gas, or petroleum vapors, methane calibration is the most common. The LEL of methane is 5% by volume in air; therefore, an air mixture containing 5% methane will be read as 100% LEL and is explosive. When combustible gases other than methane are sampled, the relative response of the detector must be considered. Recalibration to other gases may be possible (see the manufacturer's recommendations), and National Bureau of Standards (NBS) traceable calibration gases should be used. The relative sensitivity of the detector and the differences in LEL for different gases will produce varying meter responses. Correlation equations that will convert the percent LEL (based on methane) indicated by the instrument to a percent LEL for another combustible gas can usually be found in the CGI operating manual. Many units have alarm systems that can be adjusted for various LELs, and several incorporate oxygen analyzers.

2.1. Definitions

A. Lower Explosive Limit (LEL)

The LEL (also LFL, lower flammability limit) is defined as the lowest concentration of gas or vapor in air by volume that can be ignited and cause an explosion or flame propagation.

B. Upper Explosive Limit (UEL)

The UEL (also UFL, upper flammability limit) is the concentration of gas in air above which there is insufficient oxygen available to support combustion and an explosion is unlikely. A flame, however, may burn at the gas/air interface. Should additional air enter the mixture, a very explosive atmosphere may develop.

2.2. Instrument Limitations

A. Of the many instruments commercially available for detecting combustible or explosive gas, some are not certified safe for operation in the atmospheres they can detect. It is important to use only those instruments that are certified safe for use in atmospheres greater than 25% of the LEL. The instrument manufacturer's operating manual should be consulted to determine safety certification in specific atmospheres.

B. Combustible gas measurement instruments do not indicate if a given atmosphere contains hazardous or toxic compounds.

C. The CGI cannot be used in atmospheres containing silanes, silicones, silicates, or other compounds containing silicon because these substances seriously impair the instrument response.

D. If the detector has a platinum filament, its sensitivity may be reduced by exposure to gases like leaded gasoline vapors (tetraethyl lead), sulfur compounds (mercaptans and hydrogen sulfide), and sulfide compounds. An inhibitor filament that will nullify the effect of leaded gasoline vapors is available on some commercial units (Mine Safety Appliances Company, Model 260 Portable Combustible Gas and Oxygen Alarm). The instrument manufacturer's operating manual should be consulted to determine the instrument's ability to function in leaded gasoline atmospheres.

E. An oxygen detector should be used in conjunction with a CGI. Select a unit with this feature and follow the operating manual when the oxygen detector is calibrated and used. This is especially important when atmospheres are monitored within enclosed spaces or where oxygen deficient atmospheres (<19.5%) may exist.

F. Unusually high concentrations of sulfur dioxide, fluorine, chlorine, bromine, iodine, and oxides of nitrogen cause measurement interference.

G. Combustible gas indicator instruments must be calibrated frequently. Using an NBS traceable calibration gas, consult the manufacturer's operating manual for calibration frequency. Also, frequent calibration

will be necessary if several known organic species are present. Maximum accuracy requires a recalibration for each gas.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Perform a minimal check of the CGI in the office to ensure that it is functioning properly. Obtain the CGI, its operating manual, and a supply of NBS traceable gas. Methane is the factory calibration gas, but other gases may be used for specific requirements. Perform the equipment checks described below.

1. Make sure the instrument is clean and serviceable, especially sample lines and detector surfaces.

2. Check the battery charge level. If in doubt, charge the battery as described in the operating manual. Some units have charge level meters, while others have only low charge alarms.

3. Turn the unit to the on position and allow the instrument sufficient warmup time.

4. Verify that the sample pump is operable when the analyzer is on. The pump can usually be heard when operating.

5. With the intake assembly in combustible gas-free ambient air, zero the meter by rotating the zero control until the meter reads 0% LEL. For instruments with an additional oxygen meter, adjust the dial to 21% oxygen in nonhazardous locations.

6. Calibrate the unit against a known concentration of a calibration gas like hexane by rotating the calibration control (span or gain) until the meter reads the same concentration as the known standard.

7. Some instruments, like the Gas Tech Model 1314, require internal calibrating with a small screwdriver. Consult the operating manual before calibration. With this model, it is also necessary to maintain the proper flow rate during calibration. Connect a flow meter between the CGI and the calibration gas cylinder to monitor the flow rate.

8. The Gas Tech Model 1314 and others are equipped with three meters that read in percent O_2, percent LEL, and ppm. A correctly calibrated instrument for determining percent LEL is critical for monitoring many work environments. The percent oxygen is usually factory calibrated and should not be adjusted in the field. The ppm dial is often not used in the field unless a Photoionization Detector (PID) or Flame Ionization Detector (FID) is not available, as these instruments are considered to be more accurate.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes and location IDs used in the completion of data forms.

3.2.3. Field

A. Instrument Check

Before using the CGI in the field, follow the procedures in Section 3.2.1.D. Additional adjustments may be made. If necessary, adjust the alarm setting to the appropriate combustibility limit. The action level or the point at which activities are halted and personnel removed from the immediate vicinity is usually less than 25% of the LEL for the gases that are present.

B. Record necessary calibration data in the logbook and include the information listed below.

1. Date and time of arrival at the site

2. Site identification

3. Instrument, model number, and serial number

4. Date/time calibrated

5. Calibration gas used

6. Calibration location

7. Operator's signature

3.3. Operation

3.3.1. Field Measurements

A. Calibrate the CGI daily before use in the field. The calibration procedure for the Gas Tech Model 1314 is outlined in Appendix 5.4. Also, consult the manufacturer's manual.

B. Complete the Combustible Gas Indicator Monitoring Data form (Appendix 5.2) as described in Appendix 5.3, Data Form Completion.

C. Position the intake assembly close to the area in question to get an accurate reading. For readings taken downhole during drilling, there will be a slight delay between positioning the intake tubing downhole and registering accurate meter readings because of the time required for the sample to travel the length of the tube.

D. In general, combustible gas indicator instruments respond in the manner described below.

1. The meter indicates 0.5 LEL (50%). This means that 50% of the concentration of combustible gas needed to reach an unstable combustible situation is present. If the LEL of the gas is 5% in air, then the instrument indicates the presence of a 2.5% mixture.

2. The meter needle stays above 1.0 LEL (100%). This means that the concentration of combustible gas is greater than the LEL and less than the UEL. Therefore, the concentration is immediately combustible and explosive.

3. The meter needle rises above the 1.0 (100%) mark and then returns to zero. This response indicates that the ambient atmosphere has a combustible gas concentration greater than the UEL.

E. Personnel should evacuate the area if any of the events listed below occur.

1. Sounding of the alarm

2. Readings that reach the action levels designated in the Health and Safety Plan

3. Malfunctioning of the CGI

4. Condition encountered or suspected that indicates oxygen enrichment or depletion of the atmosphere (specially designed units are available for operation in those atmospheres)

F. Some important factors to keep in mind during use are listed below.

1. Slow, sweeping motions of intake or cell assembly will help ensure that problem atmospheres are not bypassed. Cover an area from floor (ground) to ceiling, the breathing zone, and areas where maximum concentrations may be expected (for example, downhole during drilling).

2. Operation of the unit in temperatures outside the recommended operating range may compromise the accuracy of readings or damage the instrument. Check the operating manual for the temperature limitations of a particular model.

3. Many combustible gas indicators are not designed for use in oxygen-enriched or depleted atmospheres. If this condition is encountered or suspected, personnel should evacuate the area. Specially designed units are available for operation in those atmospheres.

4. Use an oxygen detector in conjunction with a CGI. Select a unit and follow the operating manual for calibration and use of the oxygen detector.

5. Calibrate the equipment regularly and charge the battery after each field use. See the operating manual for details.

6. The operator should fully understand the operating principles and procedures for the specific CGI in use.

3.4 Postoperation

3.4.1 Field

A. When the activity is completed or at the end of the day, carefully clean the outside of the CGI with a damp disposable towel to remove any visible dirt. Return the CGI to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCE

EPA. 1984. "Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, Second Edition," U.S. Environmental Protection Agency report EPA-600/4-84-076. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Combustible Gas Indicator Monitoring Data Form

5.3. Data Form Completion

5.4. Calibration Procedure for Gas Tech Model 1314

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ CGI

_____ Battery charger for CGI

_____ Oxygen sensor

_____ Battery charger for oxygen sensor

_____ Spare gas detector filaments

_____ Spare batteries for CGI

_____ Jeweler's screwdrivers for internal adjustment

_____ Calibration kit

A) Spare gas cylinder (NBS traceable calibration gas)
B) Valve attachment
C) Flexible tubing (tygon)
D) Cylinder to encapsulate sensor probe

_____ Probe extensions

APPENDIX 5.2

COMBUSTIBLE GAS INDICATOR MONITORING DATA FORM

COMBUSTIBLE GAS INDICATOR (CGI) MONITORING DATA

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD REP _____

CGI MANUFACTURER _____ CGI MODEL NO _____

SERIAL NO _____ CALIBRATION DATE/TIME _____

ACCEPTANCE CODE _____ BATTERY CONDITION _____

CALIBRATION GAS (%LEL):
TYPE _____ CONCENTRATION _____ % LEL CYLINDER SERIAL NO _____

CALIBRATION GAS (PPM):
TYPE _____ CONCENTRATION _____ PPM CYLINDER SERIAL NO _____

COMMENTS _____

LOCATION ID OR DESCRIPTION	COORDINATES (FT)		MONITORING TIME (HH:MM)	LOCATION TYPE	% LOWER EXPLOSIVE LIMIT	PPM	% OXYGEN
	NORTH	EAST					

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

LOCATION TYPES: BH – BOREHOLE SL – SURFACE LOCATION TP – TEST PIT WL – WELL

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

CGI–101 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

COMBUSTIBLE GAS INDICATOR MONITORING DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained, in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. CGI Manufacturer. The company that manufactured the CGI.

6. CGI Model No. The model number of the CGI.

7. CGI Serial No. The serial number of the CGI.

8. CGI Calibration Date/Time. The date and time when the CGI was last calibrated.

9. Acceptance Code. One-character code assigned by the site manager.

10. Battery Condition. The battery charge reading at the beginning of the measurement.

11. Calibration Gas (% LEL). This information consists of three data fields: the chemical name of the calibration gas (type), concentration of the calibration gas (% LEL), and the serial number of the gas cylinder.

12. Calibration Gas (ppm). This information consists of three data fields: the chemical name of the calibration gas (type), concentration of the calibration gas (ppm), and the serial number of the gas cylinder.

13. Comments. Any additional information.

14. Location ID or Description. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

15. Coordinates (Ft). The location of the measurement of the survey grid in units of feet. The two coordinate fields are in the format north, east.

16. Monitoring Time (HH:MM). The time when a field measurement was taken in the format hours:minutes using a 24-hr clock. Example: 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m. (See conversion table below.)

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

17. Location Type. Code describing the location of the CGI reading. The location type codes are: BH--borehole, TP--test pit, SL--surface location, and WL--well.

18. Percent Lower Explosive Limit. The reading obtained with the meter set to the LEL Scale.

19. PPM. The reading with the meter set to the PPM scale.

20. Percent Oxygen. Record the percent oxygen reading in this data field.

APPENDIX 5.4

CALIBRATION PROCEDURE FOR GAS TECH MODEL 1314

GASTECH MODEL 1314 CALIBRATION

CALIBRATION PROCEDURE

1. PPM RANGE
   - 1.01 Turn on instrument, allow to warm up and adjust zero in normal way.
   - 1.02 Add a few drops of water to glass wool packing inside humidifier. Glass wool should be moist but not dripping.
   - 1.03 Couple flowmeter to Cliplok fitting, and humidifier to flowmeter inlet, as shown.
   - 1.04 Couple Cliplok fitting to instrument inlet.
   - 1.05 Readjust zero as required after instrument stabilizes.
   - 1.06 Note flowmeter reading.
   - 1.07 Connect calibration valve to ppm-range cylinder. Open valve slightly to produce a small flow.
   - 1.08 Couple valve outlet to humidifier inlet.
   - 1.09 Adjust valve to give same flow on flowmeter as observed in 1.06.
   - 1.10 Watch meter as gas enters instrument. Observe highest reading.
   - 1.11 Compare reading with marked gas concentration on cylinder.
   - 1.12 If not correct, adjust calibration as shown in Section V of Instruction Manual.
   - 1.13 Turn off valve and disconnect calibration components.
2. LEL Range

   Use same procedure as above, but in LEL range. However, omit humidifier as it is not necessary in LEL range. Use LEL range cylinder.

GMC-130 (1/88)

STANDARD OPERATING PROCEDURE 6.2

HEALTH AND SAFETY MONITORING OF ORGANIC VAPORS WITH A PHOTOIONIZATION DETECTOR

1. PURPOSE

To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable photoionization detector (PID).

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of the given operation and the applicability of this procedure to the work activities.

The PID is useful as a general survey instrument at hazardous waste sites. A PID is capable of detecting and measuring real-time concentrations of many organic and inorganic vapors in the air. A PID is similar to a flame ionization detector (FID) in application. The PID has somewhat broader capabilities because it can detect certain inorganic vapors. Conversely, the PID is unable to respond to certain low molecular weight hydrocarbons (like methane and ethane) that are readily detected by FID instruments. Appendix 5.1 describes the application comparisons between an FID organic vapor analyzer and a PID.

A PID will respond to most vapors that have an ionization potential less than or equal to that supplied by the ionizing source in the detector, which is an ultraviolet (UV) lamp. Several probes are available for the PID, each having a different source and a different ionization potential. For this reason, the selection of the appropriate probe is essential in obtaining useful field results. Though it can be calibrated to a particular compound, the instrument cannot distinguish between detectable compounds in a mixture of gases. Therefore, it indicates an integrated response to the mixture.

2.1. PID Instrument Limitations

A. The PID is a nonspecific total vapor detector. It cannot be used to identify unknown substances; it can only quantify them.

B. The PID must be calibrated to a specific compound.

C. The PID does not respond to certain low molecular weight hydrocarbons like methane and ethane.

D. Certain toxic gases and vapors like carbon tetrachloride and hydrogen cyanide have high ionization potentials and cannot be detected with a PID.

E. Certain models of PID instruments are not intrinsically safe. Refer to the manufacturer's operating manual for use in potentially flammable or

combustible atmospheres. A PID should be used in conjunction with a combustible gas indicator (see SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels).

F. Electrical power lines or power transformers close to the PID instrument may cause measurement errors. Under this circumstance, refer to the operating manual for proper procedures.

G. High winds and high humidity will affect measurement readings. Certain models of PID instruments become unusable under foggy conditions. An indication of this is the needle dropping below 0.

H. The lamp window must be periodically cleaned to ensure ionization of the air contaminants.

I. One PID instrument, the HNu, measures concentrations from about 1 to 2000 ppm, although the response is not linear over this entire range. For example, the response to benzene is linear from about 0 to 600 ppm. This means the HNu reads a true concentration of benzene only between 0 and 600. Greater concentrations are read at a lower level than the true value. Consult the manufacturer's operating manual to determine the instrument's response to various chemicals.

2.2. Regulatory Limitations

A. Transport of calibration gas cylinders by passenger and cargo aircraft follow the U.S. Code of Federal Regulations, 49 CFR Parts 100-177. Benzene is a typical calibration gas included with a PID. Benzene is classified as a nonflammable gas, UN 1556, and the proper shipping name is compressed gas. It must be shipped in cargo aircraft only.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.1	Health and Safety Monitoring of Combustible Gas Levels

3.2. Preparation

3.2.1 Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.2. Perform the procedures described below.

1. Start-Up Procedure

   a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug interface. Do not use excessive force.

   b. Turn the function switch to the battery check position. The needle on the meter should be within or above the green battery arc on the scale; if not, recharge the battery. If the red indicator light comes on, the battery needs recharging.

   c. Turn the function switch to any range setting. Look into the end of the probe to see if the lamp is on. If it is on, it will emit a purple glow. Do not stare into the probe any longer than 3 sec. Long-term exposure to UV light will damage the eyes. Also, listen for the hum of the fan motor.

   d. To zero the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed because this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted (if necessary). Wait 15 to 20 sec to ensure that the zero reading is stable. If necessary, readjust the zero.

2. Operational Check

   a. Follow the start-up procedure.

   b. With the instrument set on the 0 to 20 range, hold a solvent-based marker pen near the probe tip. If the meter deflects upscale, the instrument is working.

3. Calibration Procedure

   a. Follow the start-up procedure and the operational check.

   b. Set the function switch to the range setting for the concentration of the calibration gas.

c. Remove the detector from the outer casing by loosening the screw on the bottom of the casing.

d. Attach a regulator to a disposable cylinder of calibration gas. Connect the regulator to the probe of the PID with a piece of clean tygon tubing. Open the valve on the regulator.

e. After 15 sec, adjust the internal calibration screw until the meter reading equals the concentration of the calibration gas used. Consult the operating manual for the location of this screw.

f. If the PID does not start up, check out or calibrate properly and notify the equipment manager immediately. Under no circumstances should work requiring monitoring with a PID be performed without a properly functioning instrument.

g. Replace the detector in the outer casing.

h. Contact the carrier that will transport equipment and hazardous materials to obtain information on regulations and specifications.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record the calibration data on the Photoionization Detector Field Data form (Appendix 5.3). See Appendix 5.4 (Data Form Completion) for instructions.

3.2.3. **Field**

A. Follow the start-up procedure, operational check, and calibration check described in Section 3.2.1.D.

B. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0 to 20 ppm range; adjust the range if necessary.

C. With the exception of the probe's inlet and exhaust, wrap the PID in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside the instrument in the event of precipitation.

3.3. Operation

3.3.1 Measuring organic vapor levels using the PID

A. As with any field instrument, accurate results depend on the operator's knowledge of the operator's manual. Follow the instructions in the operating manual explicitly in order to obtain accurate results.

B. Position the intake assembly close to the monitoring area because the low sampling rate allows for only very localized readings. Do not immerse the intake assembly in fluid under any circumstances.

C. While taking care not to permit the PID to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the site Health and Safety Plan. Conduct the PID survey at a slow to moderate rate of speed and slowly sweep the intake assembly (the probe) from side to side.

D. During drilling activities, perform PID monitoring at every 5-ft interval downhole, at the headspace, and in the breathing zone. In addition, monitoring may be performed in the breathing zone during actual drilling when elevated organic vapor levels are encountered. When the activity being monitored does not involve drilling (like surface sampling), readings may only be recorded in the breathing zone. Refer to the site Health and Safety Plan for specific monitoring instructions.

E. Be prepared to evacuate the area if the preset alarm sounds. Operators using supplied air systems may not need to evacuate the work area, but they should frequently observe the levels indicated by the instrument.

F. Static voltage sources like power lines, radio transmissions, or transformers may interfere with measurements. See the operator's manual for a discussion of necessary considerations.

3.4. Postoperation

3.4.1. Field

A. When the activity is completed or at the end of the day, carefully clean the outside of the PID with a damp disposable towel to remove any visible dirt. Return the PID to a secure area and place on charge.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment and charge the batteries. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

HNU Systems, Inc. 1986. "Instruction Manual for the Trace Gas Analyzer Model PI 101." Newton, Massachusetts.

CFR 49. 1985. Code of Federal Regulations, Title 49, U.S. Department of Transporatation, Parts 100-177. November 1, 1985. Washington, D.C.: U.S. Government Printing Office.

EPA. 1984. "Characterization of Hazardous Waste Sites--A Methods Manual: Volume II, Available Sampling Methods, Second Edition" U.S. Environmental Protection Agency report EPA-600/4-84-076. Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, Nevada.

5. APPENDIXES

5.1. Comparison of the FID and PID

5.2. Equipment and Supplies Checklist

5.3. Photoionization Detector Field Data Form

5.4. Data Form Completion

APPENDIX 5.1

COMPARISON OF THE FID AND PID

	FID	PID
Response	Responds to many organic gases and vapors, especially low molecular weight hydrocarbons.	Responds to many organic and some inorganic gases and vapors, especially heavy hydrocarbons.
Application	In survey mode, detects total concentrations of gases and vapors. In GC mode, identifies and measures specific compounds.	In survey mode, detects total concentrations of gases and vapors. Some identification of compounds possible if GC column and standards are used.
Limitations	Does not respond to inorganic gases and vapors with a higher ionization potential than the flame detector. No temperature control.	Does not respond to methane or inorganic aliphatic chlorinated solvents. Does not respond properly in presence of water vapor (high humidity). Does not detect a compound if probe (lamp) has a lower energy than compound's ionization potential.
Calibration gas	Methane and others	Benzene (1,3-butadiene) and others
Ease of operation	Requires experience to interpret correctly, especially in GC mode.	Fairly easy to use and interpret. More difficult in the GC mode.
Detection limits	0.1 ppm (methane)	0.1 ppm (benzene), depends on lamp voltage.
Response time	2-3 sec (survey mode)	3 sec for 90% of total concentration

APPENDIX 5.1, Continued

	FID	PID
Maintenance	Periodically clean and inspect particle filters, valve rings, and burner chamber. Check calibration and pumping system for leaks. Recharge battery after each use.	Clean UV lamp frequently. Check calibration regularly. Recharge battery after each use.
Useful range	0-1000 ppm	0-2000 ppm
Service life	8 hrs; 3 hrs with strip chart recorder	10 hrs; 5 hrs with strip chart recorder

APPENDIX 5.2

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Photoionization detector (PID)

_____ Operating manual

_____ Probes: 9.5eV_____, 10.2eV_____, and 11.7eV_____

_____ Battery charger for PID

_____ Spare batteries

_____ Jeweler's screwdriver for adjustments

_____ Tygon tubing

_____ NBS traceable calibration gas (type)_____

_____ "T" valve for calibration

_____ Intake assembly extension

_____ Strap for carrying PID

_____ Teflon tubing for downhole measurements

_____ Plastic bags for protecting the PID from moisture and dirt

APPENDIX 5.3

PHOTOIONIZATION DETECTOR FIELD DATA FORM

PHOTOIONIZATION DETECTOR FIELD DATA

FACILITY CODE _____ **LOG DATE** _____

LOCATION ID _____ LOCATION TYPE _____

LOGGER CODE _____ FIELD REP _____

PHOTOIONZATION DETECTOR INSTRUMENT: MODEL _____

MANUFACTURER _____ DATE/TIME CALIBRATED _____

SERIAL NO _____ **ACCEPTANCE CODE** _____

CALIBRATION GASES:	
TYPE/CYLINDER ID NO	CONCENTRATION (PPM)/SPAN
1	1
2	2

COMMENTS _____

TIME (HH:MM)	SAMPLE ID	OBSERVED READING (ppm)					DRILLING DEPTH (FT)	COMMENTS
		DH	HS	BZ	D	OT		

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

LOCATION TYPES:
BH – BOREHOLE
SS – SOIL SAMPLE
SL – SURFACE LOCATION
SB – SAMPLE BOTTLE
TP – TEST PIT
WL – WELL
OT – OTHER

OBSERVED READING:
D – DURING DRILLING (BZ)
DH – DOWNHOLE
BZ – BREATHING ZONE
HS – HEADSPACE
OT – OTHER

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
PHO–040 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PHOTOIONIZATION DETECTOR FIELD DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where the program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

4. Location Type. Two-character code identifying where the sample was taken. There is one location type for each location ID. Location types include those listed below.

   BH--Borehole

   TP--Test Pit

   SL--Surface Location

   WL--Well

   SB--Sample Bottle

   SS--Soil Sample

   OT--Other (explain)

5. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information on the form.

6. Field Rep. The name of the field representative.

7. PID Model. Model of photoionization detector (PID) instrument.

8. PID Manufacturer. Manufacturer's name on the PID instrument used.

9. Date/Time Calibrated. Last day and time when the PID instrument was calibrated. Calibration should be performed daily.

10. Serial No. Serial No. of PID instrument.

11. Acceptance Code. One-character code assigned by the site manager.

12. Calibration Gases

    a) Type/Cylinder ID No. Name of the calibration gas and the identification number of the cylinder.

    b) Concentration (ppm)/span. Concentration of calibration gas in parts per million (ppm) and the span setting for calibration.

13. Comments. Any additional information.

14. Time (HH:MM). The time when a field measurement was taken in the 24-hr clock format of hours:minutes (for example, 08:37 for 8:37 a.m. and 19:12 for 7:12 p.m.). See the conversion table below.

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	1:00
12:00 Noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 Midnight	24:00

15. Sample ID. When samples are being taken during a PID monitoring, the identification number or code assigned to a particular sample (like 01) is correlated with the observed readings and appropriate drilling depth (if drilling is being performed). This is useful in selecting samples for analyses and in the correlation of laboratory data with PID measurements.

16. Observed Reading (ppm). PID reading at the respective location ID in the units indicated on the meter. When the calibration gas and the gas being measured for the environment are the same, the meter reads in parts per million (ppm) during drilling. Readings may be taken downhole, at the headspace, and in the breathing zone, and data should be recorded in the appropriately marked column.

17. Drilling Depth (Ft). PID monitoring is performed every 5 ft during drilling. The depth of the drilling is listed in feet and can be given as the most recent interval (like 5-10) or as the ending depth (like 10).

18. Comments. Any additional information, including the type of gas being measured if this determination can be made (for example, by labels on drums).

STANDARD OPERATING PROCEDURE 6.4

TOTAL ALPHA SURFACE CONTAMINATION MEASUREMENTS

1. PURPOSE

To provide guidance for determining levels of total surface alpha contamination on equipment, vehicles, and personnel that have been in contact with material that was potentially contaminated with alpha-emitting radionuclides.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of a given operation, related health and safety requirements, and the applicability of this procedure to the activities.

Equipment and vehicles must be monitored for surface contamination before release for unrestricted use from a radiologically controlled area. Levels of surface alpha contamination on equipment will be determined and compared to release criteria presented in DOE Order 5480.11. These criteria are based on U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 and presented as either total average, total maximum, or removable. Total average measurements are based on portable instrument surveys for alpha contamination over a 1 m^2 area. Total maximum measurements are based on portable instrument surveys for alpha contamination over a 100 cm^2 area. Removable contamination is defined as that amount of surface alpha activity that may be transferred to a soft, dry filter paper after wiping 100 cm^2 areas of the surface with moderate pressure. The swipe is then counted in a stationary radiation detector to determine removable alpha activity.

The primary alpha-emitting radionuclide of concern at the Mound Plant is plutonium-238. In some areas, isotopes of natural uranium and thorium are also of concern. In some instances, these plutonium, uranium, and thorium sources may contaminate some equipment surfaces concurrently. It is therefore necessary to select the surface contamination limits based on the most restrictive radionuclide, plutonium-238. For plutonium-238 and other transuranics, the surface contamination limits are as follow:

Nuclide	Average	Maximum	Removable
Plutonium-238	100 dpm/100 cm^2	300 dpm/100cm^2	20 dpm/100 cm^2

Activity per unit area is reported in units of disintegrations per minute (dpm) over a 100 cm^2 surface area. Natural uranium and thorium isotopes have significantly higher release limits than plutonium-238, thus are bounded by plutonium-238 limits. It is important to note that due to the characteristics of portable alpha detection instruments, it is generally not possible to statistically detect 20 dpm/100 cm^2 on a potentially contaminated surface. Therefore, removable alpha contamination measurements must be made on all equipment used in a radiologically controlled area of the Mound site. These measurements are addressed in SOP 1.7, Sampling for Removable Alpha Contamination.

All equipment must be decontaminated to levels that are as low as reasonably achievable and below the applicable release criterion in all cases. Personnel must be monitored for

contamination before leaving a controlled area and decontaminated to the lowest reasonably achievable levels.

High-voltage plateau curves and National Bureau of Standards (NBS) traceable source calibrations must be performed on the detector semiannually to ensure proper operation. Alpha detector counting efficiencies must be determined daily before using the instrument for contamination monitoring. The counting efficiency also must be determined following any adjustments or repairs on the instrument. The counting efficiency is used to convert instrument readings to a measure of activity in units of dpm per 100 cm^2.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
1.7	Sampling for Removable Alpha Contamination
6.11	Beta-Gamma Radiation Measurements Using a Geiger-Mueller Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all field equipment. Ensure that the alpha scintillator and the ratemeter/scaler have current calibrations.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of codes used in the completion of data forms.

3.2.3. Field

A. Complete the Daily Alpha Efficiency Check form (Appendix 5.2) by following instructions in Appendix 5.4, Data Form Completion.

B. Perform a daily 10-min background count and a 1-min alpha source count during use and record the results on the Daily Alpha Efficiency Check form. To perform a background count, place the probe on a clean, uncontaminated surface and record the number of counts accumulated over a period of 10 min. To perform a check source count, place the alpha source in the detector tray or against the detector surface and record the number of counts accumulated per minute (cpm).

C. Calculate the counting efficiency (E) using the formula shown below.

$$E = \frac{(\text{source cpm}) - (\text{background cpm})}{(\text{source dpm})}$$

D. While counting samples or performing surveys, the alpha probe may be contaminated, causing the background count rate to increase. If this is suspected, repeat the 10-min background count. If the background count rate is more than 50% above the average value, the detector should be cleaned.

3.3 **Operation**

3.3.1 Total Alpha Survey

A. Complete the Total Alpha Contamination Survey Data form by following instructions in Appendix 5.4, Data Form Completion.

B. List the items to be surveyed in the first column on the form. Items must be identified as specifically as possible with serial numbers, model numbers, license numbers, or other forms of unique descriptions. If the items to be surveyed need to be labeled with the assigned identification number, use an indelible marker, spray paint, or some type of permanent marker. Use a separate line of the form to list each area surveyed on the items.

C. List the surveyor's name, date of survey, and identification number of the monitoring instrument/detector.

D. Switch the instrument on, check the batteries for adequate power, and check the instrument for damage. Record the instrument daily background, efficiency, and calibration factor in the appropriate spaces. The instrument background and efficiency should be determined at least once during each operational day.

E. Monitor potentially contaminated surfaces by passing the probe face along each surface at a rate of 5 cm/sec or less. Without touching it, hold the probe face as close as possible to the surface being monitored and not more than 0.5 cm away. Be careful not to damage the Mylar face of the probe. Hold the probe steady at any area that appears to indicate an elevated reading. Record the highest reading for each separate area of the item monitored, listing a description of each area in the space provided under the first column.

F. When monitoring potentially contaminated skin and clothing surfaces, hold the probe face as close as possible to the surface being monitored, no more than 0.5 cm away. Move the probe along the surface at a rate of 5 cm/sec or less. At a minimum, monitor the areas listed below.

1. Both sides of each hand

2. Tops, sides, and bottoms of shoes or boots

3. The torso of the body, both front and back

4. All loose equipment (for example, papers, clipboards, and hand-carried tools)

G. Instrument readings will fluctuate during monitoring. Investigate any significant elevation of the meter reading by holding the meter in the suspected area. A noticeable elevation in the meter reading identifies contamination that may need to be removed.

H. Multiply each instrument reading (cpm) by the calibration factor to obtain the contamination level in dpm/100 cm^2.

I. If the radiologically controlled area is known or suspected to contain plutonium-238, perform the swipe or smear survey procedure. See SOP 1.7, Sampling for Removable Alpha Contamination.

J. Wash contaminated skin and equipment with water and soap. Contaminated clothing may be removed and laundered at an appropriate facility.

K. Give the survey results to the personnel responsible for releasing equipment. Equipment that fails to meet the release limits must undergo additional decontamination according to SOP 1.6, General Equipment Decontamination, and must be resurveyed.

3.4. Postoperation

3.4.1. Field

A. Turn the power off.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCE

NRC. 1974. Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." U. S. Regulatory Commission, Washington, D.C.: U.S. Government Printing Office.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Daily Alpha Efficiency Check Form

5.3. Total Alpha Contamination Survey Data Form

5.4. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Alpha scintillation probe (Ludlum 43-5 or the equivalent)

_____ Ratemeter/scaler (Ludlum Model 3 or the equivalent)

_____ Alpha check source (Am-241 or the equivalent)

_____ Data forms

_____ Voltage meter

_____ Hand-held calculator

_____ Tape measure

APPENDIX 5.2

DAILY ALPHA EFFICIENCY CHECK FORM

DAILY ALPHA EFFICIENCY CHECK

FACILITY CODE _____ FIELD REP _____

LOGGER CODE _____ **ACCEPTANCE CODE** _____

RATEMETER/SCALER:

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW OUT THRESHOLD _____ HIGH VOLTAGE _____ BATTERY _____

ALPHA SCINTILLATION PROBE:

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

SOURCE:

SERIAL NO _____ ISOTOPE _____ ACTIVITY _____ DPM

LOG DATE	TIME (HH:MM)	COUNTING TIME (MIN)	BACKGROUND CPM	GROSS COUNTS	GROSS CPM	NET CPM	EFFICIENCY (NET CPM/DPM)

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
DAE–103 (3/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.3

TOTAL ALPHA CONTAMINATION SURVEY DATA FORM

TOTAL ALPHA CONTAMINATION SURVEY DATA

FACILITY CODE ..... **LOG DATE** .....

LOGGER CODE ..... FIELD REP .....

RATEMETER/SCALER: **ACCEPTANCE CODE** .....

MODEL NO ..... SERIAL NO ..... CALIBRATION DATE .....

WINDOW OUT ..... THRESHOLD ..... HIGH VOLTAGE ..... BATTERY .....

ALPHA PROBE:

MODEL NO ..... SERIAL NO ..... EFFICIENCY ..... CPM/DPM

PROBE FACE AREA [1] ..... CALIBRATION FACTOR [2] ..... (DPM/100cm²)/CPM

ARE TRANSURANICS PRESENT OR SUSPECTED? (YES/NO) .....

IF YES -- SWIPES ARE REQUIRED

ITEM SURVEYED (SPECIFY)	GROSS COUNTS	COUNT TIME	NET CPM	CONTAMINATION [3] LEVEL (IN DPM/100cm²)	MEETS TOTAL SURFACE RELEASE LIMIT (100 dpm/cm²) / (YES/NO)	SWIPE NECESSARY (YES/NO)

1 LUDLUM MODEL 43-1 PROBE FACE AREA = 83.0cm² LUDLUM MODEL 43-5 PROBE FACE AREA = 78.5 cm²

2 CALIBRATION FACTOR = (100/PROBEFACE AREA (cm²))/EFFECIENCY(CPM/DPM)

3 CONTAMINATION LEVEL = (NET CPM)(CALIBRATION FACTOR)

ACCEPTANCE CODES: A-ACCEPTABLE R-RECONNAISSANCE U-UNACCEPTABLE N-NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
IAC - 128 (6/92)

FORM COMPLETED BY/DATE

TECHNICAL REVIEWER/DATE

APPENDIX 5.4

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

DAILY ALPHA EFFICIENCY CHECK

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Field Rep. The name of the field representative.

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Acceptance Code. One-character code assigned by the site manager.

5. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

6. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

7. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

8. Window. The window is in the out position unless otherwise specified.

9. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

10. High Voltage. The voltage that is applied to the alpha scintillation probe shown on the calibration sticker. This voltage is determined semiannually using a voltage plateau.

11. Battery. The battery voltage reading at the beginning of the measurement.

12. Alpha Scintillation Probe Model No. The model number of the alpha detector probe.

13. Alpha Scintillation Probe Serial No. The serial number of the alpha probe.

14. Alpha Scintillation Probe Calibration Date. The date the probe was last calibrated.

15. Source Serial No. The serial number of the radiation source.

16. Source Isotope. The identity of the radioactive isotope contained in the source given as element and mass number, like Am-241.

17. Source Activity. The activity of the radioactive source in disintegrations per minute (dpm). If the check source activity is given in microcuries (μCi), it can be converted to dpm using 1 μCi = 2.22×10^{6}dpm.

18. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

19. Time (HH:MM). The time the efficiency was determined using the 24-hr clock in the format hours:minutes.

20. Counting Time (Min). The time in minutes over which the scaler counts. Enter N/A if using a ratemeter.

21. Background cpm. The count rate with no source present.

22. Gross Counts. The number of pulses recorded by the scaler during the counting time. Enter N/A if using a ratemeter.

23. Gross cpm. The count rate with the source present given in pulses per minute.

24. Net cpm. Net counts per minute (cpm) equals gross cpm minus background cpm.

25. Efficiency (Net cpm/dpm). The ratio of the observed count rate to the true disintegration rate.

$$\text{Efficiency} = \frac{\text{Net cpm}}{\text{Source dpm}}$$

APPENDIX 5.4, Continued

TOTAL ALPHA CONTAMINATION SURVEY DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. High Voltage. The voltage applied to the alpha detector shown on the calibration sticker.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. Alpha Probe Model No. The model number of the alpha detector probe.

14. Alpha Probe Serial No. The serial number of the alpha detector probe.

15. Alpha Probe Efficiency. The ratio of observed net count rate to the known disintegration rate of the check source from the Daily Alpha Efficiency Check form (Appendix 5.2).

16. Probe Face Area. The surface area of the Mylar window on the alpha scintillation detector in square cm. Values for Ludlum Models 43-1 and 43-5 are listed at the bottom of the form.

17. Calibration Factor. Factor that takes the detector efficiency and surface area into account to convert from cpm to dpm per 100 cm^2. The calibration factor in (dpm/100cm^2)/cpm equals (100/Probe Face Area in cm^2)/efficiency in cpm/dpm.

18. Are transuranics present or suspected (Yes/No). Answer based on historical data and Safety Plan review.

19. Item Surveyed (Specify). A description or identification number of the article surveyed. A separate line on the form is used to list and describe each area to be surveyed on the article.

20. Gross Counts. The total counts collected during the counting period.

21. Count Time. The time (in minutes) during which the counts were collected.

22. Net cpm. Gross count cpm minus background cpm.

23. Contamination Level (in dpm/100cm^2). This is calculated by multiplying the net cpm by the calibration factor.

    Contamination level = (Net cpm) (Calibration Factor)

24. Meets Release Limit (Yes/No). If the contamination level is greater than the applicable release limit, a no is written here. If the contamination level is less than the release limit, a yes is written here.

25. Swipe Necessary (Yes/No). If the total alpha contamination level exceeds the applicable removable contamination criteria, a swipe must be performed to determined the activity contribution of fixed and loose contamination. If item 18 is Yes, all locations will require a swipe.

STANDARD OPERATING PROCEDURE 6.7

NEAR SURFACE AND SOIL SAMPLE SCREENING FOR LOW-ENERGY GAMMA RADIATION USING THE FIDLER

1. PURPOSE

To describe the procedure in which a field instrument for the detection of low-energy radiation (FIDLER) is used to monitor surfaces and soil samples for the presence of low-energy gamma radiations that accompany some alpha emissions.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of specific operations, related health and safety requirements, and the applicability of this procedure.

The FIDLER uses a thin, 5-inch-diameter sodium iodide (NaI) crystal to detect low-energy radiation. The NaI crystal is optically coupled to a quartz light pipe and installed in a standard 5-inch probe housing that has an entrance window of beryllium. The principal use of this detector is for photons with energies less than 75 kilo-electron volts (keV).

The FIDLER probe can be used to scan individual samples for low-energy photons that normally accompany alpha emissions. Uranium is principally an alpha emitter. However, the radiation from its daughter products includes low-energy photons, principally L-orbital x rays from thorium. In the case of U-238, for example, two low-energy photons from Th-234 can be detected by the FIDLER. During most investigations, the instrument will be adjusted for maximum response for the 63 keV photon from Th-234 or the 60 keV photon of Am-241 formed by the beta decay of Pu-241.

The detection limit for a FIDLER during field use is dependent on the source to detector geometry, the energy of gamma and x-rays associated with radionuclides present, and what radionuclide was used to calibrate the instrument to a calculated efficiency. A wide range in background soures can affect the estimated sensitivity as well.

Source to detector geometry can be influenced by the terrain roughness, amount and type of vegetation, and the physical configuration of the detector. These items should be noted during a field survey.

The thin NaI crystal in a FIDLER becomes less sensitive to increasing gamma and x-ray energies. It is necessary to note the energy and yield associated with potential radionuclides encountered. The energy and yield of the calibration source must also be known prior to field use. A FIDLER that has been calibrated to an americium-241 source (approximately 60 keV) may have a high voltage that is insufficient to amplify plutonium-238 (approximately 23 keV) pulses to a detector threshold.

Data from these measurements are presented as gross counts in the 60 keV energy range. The combination of this information with gross alpha counts of the same sample conducted according to SOP 6.5, Screening Soil Samples for Alpha Emitters, can be used to determine the presence or absence of radionuclides.

Included in this procedure are instructions for 1) initial instrument setup (voltage plateau), 2) daily response standardization using a sealed check source, 3) determination of the instrument's response to terrestrial background radiation, and 4) use of the instrument to scan ground surface areas and samples.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.5	Screening Soil Samples for Alpha Emitters

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all equipment.

D. Obtain appropriate permission for property access.

E. Before the FIDLER can be used in the field, it is necessary to determine the correct operating voltage. This is accomplished by determining the plateau for background radiation and for radiation from a source of Am-241 (60 keV) in which the intensity is several times greater than background radiation levels. Determine the operating voltage once each week.

1. Inspect the FIDLER, the ratemeter/scaler, and interconnecting cable for obvious damage.

2. If no damage is observed, adjust the high voltage to 0 volts before connecting the FIDLER and the ratemeter/scaler.

3. Connect the FIDLER to the ratemeter/scaler in an area that has exhibited background radiation in previous measurements.

4. Turn the ratemeter/scaler selector switch to the high voltage setting and slowly adjust the high voltage to 900 volts (V).

5. Place the FIDLER in a position so that a series of 0.5-min counts can be made at various high-voltage settings.

6. Make three 0.5-min readings and record the voltage, count time, counts, and counts per minute in the columns on the Plateau Curve Record. When these three readings have been completed, adjust the high voltage upward 40 to 50 V. Repeat the three readings. Continue this procedure until three recordings have been made at a high-voltage setting of 1400 V. Do not exceed 1400 V.

7. Place the Am-241 source approximately 1 inch from the beryllium entrance window near the center of the probe and repeat the series of 0.5-min readings for high-voltage settings between 900 and 1400 V.

8. On the Plateau Curve Record, plot the FIDLER response as a function of high voltage. Between 1100 and 1300 V, there is little change in the detector's response. This represents the operating plateau. Set the ratemeter/scaler high voltage at the midpoint of the plateau (typically 1200 V) for field operation. Minor fluctuations in the high voltage caused by environmental conditions or battery drain will have little effect on the count rate. Record this ratemeter/scaler voltage on the Plateau Curve Record form.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check and information concerning the initial setup of the FIDLER in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

E. Record information concerning the initial setup of the FIDLER on the Plateau Curve Record form (Appendix 5.2). Instructions for completing the form are in Appendix 5.5 (Data Form Completion).

3.2.3. Field

A. Daily Source Check

1. Establish a fixed geometry between the detector and the source so that their relative position is a matter of record and reproducible from one work period to the next.

2. Make five 1-min counts with the Am-241 source in its check position. Record each count in the logbook. Repeat this step twice daily when the instrument is in use or at any new locations.

3. Determine the average and standard deviation of the five 1-min counts. Record these values and three times the standard deviation in the logbook.

The average source count (X) = $\frac{x1+x2+x3+x4+x5}{5}$

The standard deviation of the average source count (SDX) = (X/5)1/2

B. Monitoring the performance of the FIDLER

1. Prepare a control chart at the beginning of the site characterization and use it each day to record the FIDLER's response to the Am-241 source.

2. On a piece of linear graph paper, place consecutive calendar dates on the x-axis. Define a range along the y-axis that includes the average FIDLER source count + 3 standard deviations. Draw three horizontal lines that intersect the y-axis at these three points.

3. Determine the average count rate and plot this value on the control chart for that day. If the average count rate falls within the +3 standard deviations as defined above, the FIDLER may be used for field measurements. If the average count rate is not within this range, corrective action must be taken (see Section 3.2.3.C).

C. Corrective Action

1. Check the ratemeter/scaler calibration due date.

2. Check to see that the ratemeter/scaler high voltage is set at the plateau midpoint.

3. Turn off the ratemeter/scaler and disconnect the cable to the FIDLER. Clean the cable and chassis connectors with ethyl alcohol and let dry.

4. Reconnect the cable, turn on the ratemeter/scaler, and check the voltage setting.

5. Check the source-to-detector distance and make any necessary corrections.

6. Repeat the daily source check procedure. If the FIDLER response is within the range of the average count rate + 3 standard deviations, the unit may be used. If the average count rate is still outside the control boundary, turn off the instrument and use a substitute instrument. Repeated failures will require attention by the manufacturer. The FIDLER is temperature sensitive and constant response will be ensured through the use of a battery-powered "warming jacket" in cold temperatures.

D. Determination of Background

1. In order to provide a statistical basis to determine if samples or locations are contaminated, calculate the mean background and standard deviation.

   a. In a location designated as background (not in the contaminated area) or using five soil samples collected from a background area, perform a series of five 1-minute counts with the FIDLER probe in the same position as it will be for screening samples in locations (see Sections 3.3.1 and 3.3.2).

   b. Determine the mean and standard deviation of the five background counts.

$$\text{Mean} = X = \frac{x1+x2+x3+x4+x5}{5}$$

where

x1, x2, x3, x4, x5 = the background counts

standard deviation = SDX = (X/5)1/2

2. The contamination criterion used for further samples is the mean background plus 3 standard deviations (X + 3SDX). Samples with 1-min counts greater than this criterion should be considered contaminated.

3. Record this number or criterion on the FIDLER Soil Sample Screening Log (Appendix 5.3) or the FIDLER Measurement Data form (Appendix 5.4), depending on the type of screening to be performed.

3.3. Operation

3.3.1 Screening Soil Samples

A. Record the soil sample screening data on the FIDLER Soil Sample Screening Log form (Appendix 5.3) following the instructions in Appendix 5.5, Data Form Completion.

B. Place the soil samples in the petri dishes (fill to the top).

C. The steps for screening samples are described below.

1. Place the soil sample container (petri dish) in the counting shield.

2. Place the FIDLER probe in a counting jig inside the lead shield so that it is positioned above the center of a sample container holder. Adjust the height so that the FIDLER is one inch above the sample container. Close the shield door.

3. Turn the ratemeter/scaler selector switch to preset time and set the time for one min. Push the reset button to start and count.

4. Record the counts and the counting time on the FIDLER Soil Sample Screening Log form.

6. Remove the sample container, store it in sample archive, and repeat with additional samples.

3.3.2. Near-Surface Screening

A. The FIDLER Measurement Data form (Appendix 5.4) is completed as described in Appendix 5.5, Data Form Completion.

B. Determine that the FIDLER system has been checked and is ready for field measurements.

C. Refer to the FSP or WP for the areas to be scanned, the number of people required, time requirements, and special instructions.

D. Subdivide the grid block squares into square (or regular) grid blocks, the total area of which can be scanned in 0.5 or 1-min intervals. Use a calibrated measurement tape.

E. Drainage paths can only be scanned with a FIDLER if the area is free of standing or flowing water. If the area is dry, place grid stakes at regular intervals between the preexisting stakes.

F. Record scan measurements as integral counts over the area to be scanned. Pulses from the FIDLER will be summed for 0.5 min or 1 min. Turn the main selector switch of the ratemeter/scaler to either 0.5 or 1 min (as specified in the FSP or WP).

G. Begin scans at one corner of a grid block and progress in a serpentine pattern over the entire block, ending at the diagonally opposite corner of the block. Push the ratemeter/scaler reset button as the scan begins. With practice, the timed count should end upon reaching the opposite corner. During the scan, the field representative must listen to the audible signal from the meter. Although scanning speed should not be slowed when increased audible signals are heard, note the presence of apparent hot spots when recording the integrated count for the scan.

H. After completing the scan for an individual grid block, record the integrated count in its respective position on the FIDLER Measurement Data form (Appendix 5.4). Place a check mark above the recorded count to signify that anomalous or hot spot areas may exist on the basis of audible signals for that grid block.

I. Compare the location count rate to the contamination criterion (average background and 3 standard deviations). If the count rate is greater, the location is marked Y for further study or characterization.

3.4. Postoperation

3.4.1. Field

A. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

B. If necessary, make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

C. Ensure that all radiological sources and standards have been stored in a locked area.

3.4.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory Equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCE

Becron. 1985. "Technical Manual, Model: Labtech Scaler/Ratemeter/Analyzer with 2-Channel Option." Bicron Corporation, Newbury, Ohio.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Plateau Curve Record

5.3. FIDLER Soil Sample Screening Log Form

5.4. FIDLER Measurement Data Form

5.5. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ FIDLER probe

_____ Ratemeter/scaler with voltage indicator and optional headphones

_____ Connector cable

_____ Lead shield and counting jig (optional)

_____ Plan view (site map) of the area to be surveyed that includes grid system coordinates

_____ Calibrated measurement tape or chain

_____ Am-241 source or the equivalent

_____ Hand-held calculator

_____ FIDLER heat shield, if available

_____ Linear graph paper for the performance control chart

_____ Petri dishes for soil samples

APPENDIX 5.2

PLATEAU CURVE RECORD

PLATEAU CURVE RECORD

PAGE 1 OF ____

FACILITY CODE _____ LOG DATE _____

LOGGER CODE _____ FIELD REP _____

RATEMETER/SCALER: ACCEPTANCE CODE _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

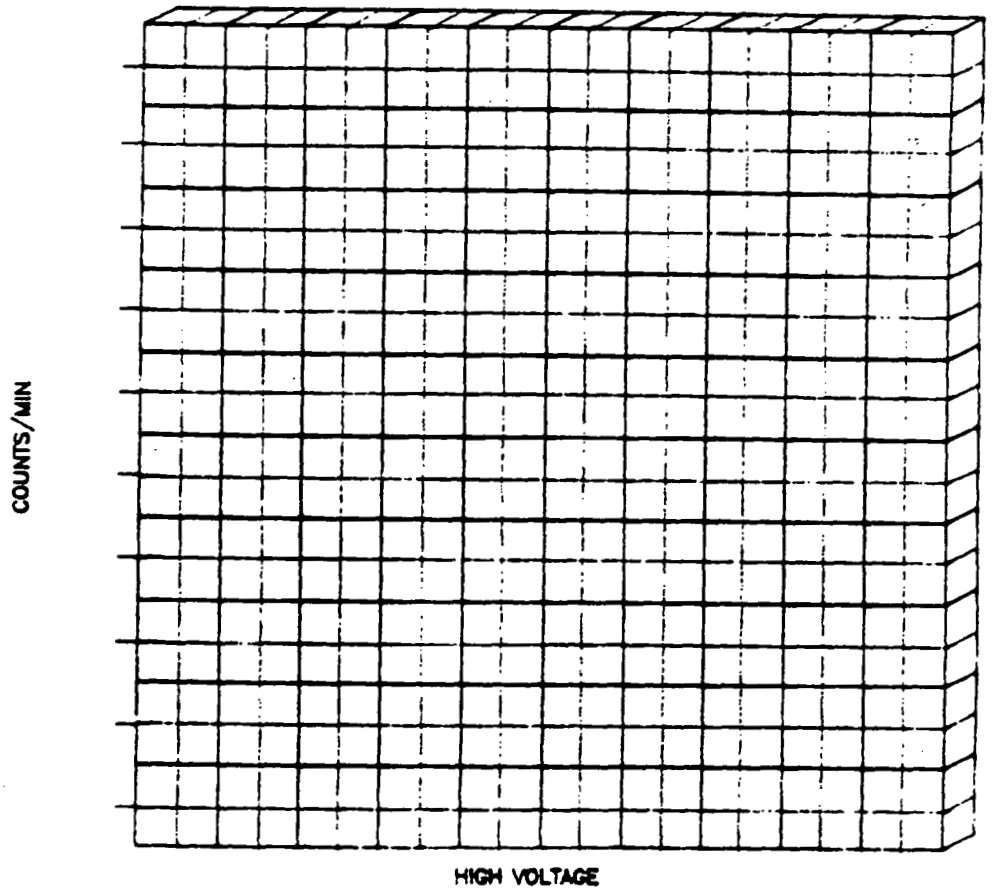
WINDOW _____ THRESHOLD _____ BATTERY _____

PROBE:

MODEL NO _____ SERIAL NO _____ HIGH VOLTAGE _____

CHECK SOURCE:

SERIAL NO _____ ISOTOPE _____ ACTIVITY _____



ACCEPTANCE CODES: A—ACCEPTABLE R—RECOMMAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS

PCR-102 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

FIDLER SOIL SAMPLE SCREENING LOG

FIDLER SOIL SAMPLE SCREENING LOG PAGE 1 OF ____

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD REP _____

RATEMETER/SCALER: **ACCEPTANCE CODE** _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW _____ THRESHOLD _____ HIGH VOLTAGE _____ BATTERY _____

NaI PROBE :

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

CHECK SOURCE:

ISOTOPE _____ ACTIVITY _____ DPM SERIAL NO _____

SOURCE CHECK

METER READING _____ COUNTS/_____ MIN = _____ CPM

(WITHIN ± 3 STANDARD DEVIATIONS?[1] _____ (Y/N))

AVERAGE BACKGROUND + 3 STANDARD DEVIATIONS = _____ CPM

COMMENTS _____

LOCATION ID	COORDINATES (FT)		SAMPLE ID	COUNTS (=CPM)	CONTAMINATED YES/NO	ESTIMATED[2] pCi/gram
	NORTH	EAST				

1 SOURCE CHECK WITHIN ± 3 STANDARD DEVIATIONS (YES/NO), FROM THE CONTROL CHART

2 THE pCi/gram RADIONUCLIDE CONCENTRATION CAN BE ESTIMATED ONLY IF FIELD CALIBRATION FACTORS ARE AVAILABLE

ACCEPTANCE CODES: A—ACCEPTABLE R—RECONNAISSANCE U—UNACCEPTABLE N—NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY IN TIMS
FSS-125 (3/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.4

FIDLER MEASUREMENT DATA FORM

FIDLER MEASUREMENT DATA

PAGE 1 OF ___

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD REP _____

RATEMETER/SCALER: **ACCEPTANCE CODE** _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW _____ THRESHOLD _____ VOLTAGE _____ BATTERY _____

NaI PROBE:

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

CHECK SOURCE:

ISOTOPE _____ ACTIVITY _____ DPM SERIAL NO _____

SOURCE CHECK

METER READING _____ COUNTS/_____ MIN = _____ CPM

(WITHIN ± 3 STANDARD DEVIATIONS?[1] _____ (Y/N)

AVERAGE BACKGROUND + 3 STANDARD DEVIATIONS = _____

COMMENTS _____

LOCATION ID	GRID BLOCK SCANNED (FROM N.E. CORNER)		INTEGRATED COUNT (CPM)	AUDIBLE (Y)es or (N)o	CONTAMINATED (Y)es or (N)o
	NORTH	EAST			

[1] SOURCE CHECK WITH ± 3 STANDARD DEVIATIONS, (YES/NO) FROM THE CONTROL CHART

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TMS
FMD–120 (3/88)

FORM COMPLETED BY/DATE

TECHNICAL REVIEWER/DATE

APPENDIX 5.5

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

PLATEAU CURVE RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. Battery. The battery voltage reading at the beginning of the measurement.

12. Probe Model Number. The model number of the FIDLER probe.

13. Probe Serial Number. The serial number of the FIDLER probe.

14. Probe High Voltage. The final voltage setting that will be applied to the detector, as determined by the Plateau Curve procedure. For the FIDLER, the operating voltage should be about 1200V.

15. Check Source Serial No. The serial number of the radiation check source.

16. Check Source Isotope. The radioactive isotope contained in the check source given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the radioactive check source in disintegrations per minute (dpm). An activity given in microcuries (lCi) can be converted to dpm using 2.22 x 106 dpm = 1 lCi.

18. Counts/Min. The count rate given in counts per minute (cpm).

19. High Voltage. The voltage applied to the detector during the collection of the associated counts.

FIDLER SOIL SAMPLE SCREENING LOG

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. High Voltage. The voltage setting that is applied to the probe as determined by the Plateau Curve procedure.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. NaI Probe Model No. The model number of the FIDLER probe.

14. NaI Probe Serial No. The serial number of the FIDLER probe.

15. NaI Probe Calibration Date. The date when the FIDLER probe was last calibrated.

16. Check Source Isotope. The radioactive isotope that the source contains, given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the check source, measured in disintegrations per minute (dpm). An activity given in microcuries can be converted to dpm using 2.22 x 106 dpm = 1 lCi.

18. Check Source Serial No. The serial number of the check source.

19. Source Check Meter Reading. The results of a count on a check source. The check source data consists of three fields: total counts, counting time in minutes, and count rate in counts per minute (cpm).

20. Within + 3 Standard Deviations (Y/N). This field describes the performance of the FIDLER, from the control chart in 3.2.3.B., Field Preparation.

21. Average Background + 3 Standard Deviations (cpm). This field gives the average background count rate + 3 standard deviations of the average count rate. It is used as a contamination criterion. Count rates greater than this are considered contaminated. Count time equals 1 min.

    $$X = \text{Average or Mean Background} = \frac{x1+x2+x3...xn}{N}$$

    where

    x1, x2, x3 etc = individual background counts

    N = the number of counts taken

    SDX = standard deviation of the average background = (X/N)1/2

22. Comments. Any additional information.

23. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

24. Coordinates (Ft). The location of the FIDLER measurement on the survey grid in units of feet. The two coordinate fields are in the format north and east.

25. Sample ID. The identifying code or number given to the sample.

26. Counts (=cpm). The number of counts registering on the FIDLER meter during the 1-min counting period.

27. Contaminated (Yes/No). If the counts per 1 min obtained are greater than the average background plus 3 standard deviations, the sample is considered contaminated. Enter Yes or Y if contaminated and No or N if not contaminated.

28. Estimated pCi/gram. If calibration factors are available for the specific site under investigation, the FIDLER cpm can be converted to a pCi/gram concentration. Enter N/A if these factors are not available.

APPENDIX 5.5, Continued

FIDLER MEASUREMENT DATA FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date the information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Window. The window will be in the out position unless otherwise specified.

10. Threshold. The adjustment for the lower energy level of the discriminator shown on the calibration sticker.

11. Voltage. The voltage setting that is applied to the probe, as determined by the Plateau Curve procedure.

12. Battery. The battery voltage reading at the beginning of the measurement.

13. NaI Probe Model No. The model number of the FIDLER probe.

14. NaI Probe Serial No. The serial number of the FIDLER probe.

15. NaI Probe Calibration Date. The date when the FIDLER probe was last calibrated.

16. Check Source Isotope. The radioactive isotope that the source contains, given as element and mass number, like Am-241.

17. Check Source Activity. The activity of the check source, measured in disintegrations per minute (dpm). An activity given in microcuries (lCi) can be converted to dpm using 2.22 x 106 dpm = 1 lCi.

18. Check Source Serial No. The serial number of the check source.

19. Source Check Meter Reading. The results of a count on a check source. Check source data consists of three fields: total counts, count time in minutes, and count rate in cpm.

20. Within + 3 Standard Deviations. This field describes the performance of the FIDLER, from the control chart in Section 3.2.3.B, Field Preparation. Enter Y (yes) or N (no).

21. Average Background + 3 Standard Deviations. This field gives the average background count rate (cpm) + 3 standard deviations of the average. It is used as a contamination criterion; count rates greater than this number indicate contaminated areas.

    $$X = \text{Average or Mean Background} = \frac{x1+x2+x3...xn}{N}$$

    where

    x1, x2, x3, etc. = individual background counts

    N = the number of counts taken

    SDX = standard deviation of the average background = $(X/N)^{1/2}$

22. Comments. Any additional information.

23. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

24. Grid Block Scanned (From N.E. Corner). The location of the grid block that was scanned, identified by the survey coordinates of the northeast corner relative to the survey grid in units of feet. There are two fields in the coordinate description: north and east.

25. Integrated Count (cpm). The count rate in counts per minute obtained from the walkover scan of the grid.

26. Audible. If an audible anomaly was noted, enter YES; if no audible anomaly was detected, enter NO.

27. Contaminated. If the count rate recorded is greater than the average background plus 3 standard deviations, the location is considered contaminated (Y). If it is less, it is not considered contaminated (N).

STANDARD OPERATING PROCEDURE 6.11

BETA-GAMMA RADIATION MEASUREMENTS

1. PURPOSE

To provide guidance for determining levels of total surface beta contamination on equipment, vehicles, and personnel that have been in contact with material that was potentially contaminated with beta-emitting radionuclides. To describe the methodology for measuring beta-gamma radiation levels.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of specific operations, related health and safety requirements, and the applicability of this procedure to the activities.

Equipment and vehicles must be monitored for surface contamination before release for unrestricted use from a radiologically controlled area. Levels of surface beta contamination on equipment will be determined and compared to release criteria presented in DOE Order 5400.5. These criteria are based on U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 and presented as either total average, total maximum, or removable. Total average measurements are based on portable instrument surveys for beta contamination over a 1 m^2 area. Total maximum measurements are based on portable instrument surveys for beta contamination over a 100 cm^2 area. Removable contamination is defined as that amount of surface beta activity that may be transferred to a soft, dry filter paper after wiping 100 cm^2 areas of the surface with moderate pressure. The swipe is then counted in a stationary radiation detector to determine removable beta activity. The scope of this procedure, however, is not to include removable beta determination.

Potential hazards from radionuclides that are beta-gamma emitters (like cesium-137) arise from ingestion or inhalation and external radiation that penetrates critical body organs. Protection requires the measurement and control of internal and external pathways.

Beta and gamma radiations are considered together because many radioactive materials emit both. The techniques for measuring the two are similar. A calibration source should be selected that most closely represents the energies of the radiation field to be measured.

Activity per unit area is reported in units of disintegrations per minute (dpm) over a 100 cm^2 surface area.

All equipment must be decontaminated to levels that are as low as reasonably achievable and below the applicable release criterion called out in DOE Order 5400.5. Personnel must be monitored for contamination before leaving a controlled area and decontaminated to the lowest reasonably achievable levels.

High-voltage plateau curves and National Bureau of Standards (NBS) traceable source calibrations must be performed on the detector semiannually to ensure proper operation. Beta detector counting efficiencies must be determined daily before using the instrument for contamination monitoring. The counting efficiency also must be determined following any adjustments or repairs on the instrument. The counting efficiency is used to convert instrument readings to a measure of activity in units of dpm per 100 cm^2.

For general beta-gamma radiation monitoring, the ionization chamber and the Geiger-Müller (GM) counter are the primary instruments. Only the technique using the GM counter will be described here.

Portable GM counters have battery-operated power supplies and amplifiers. The sensitive element is a small Geiger tube contained in a probe. The probe is attached to a ratemeter/scaler that has several different scales, a time-response switch, and an audible output.

The primary beta-emitting radionculdie of concern at the Mound Plant is cesium-137. The surface contamination limits are as follows:

Nuclide	Average	Maximum	Removable
Cesium-137	5,000 dpm β/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1,000 dpm $\beta\gamma$/100 cm^2

Two GM probe configurations are described in this procedure: a pancake probe and an energy-compensated tube. The pancake probe consists of a flat, thin-windowed GM tube in a shielded housing. It measures radiation coming primarily from in front of the thin window and is used for measuring beta-gamma contamination on surfaces. The energy-compensated probe is typically a thick-walled GM tube measuring 4 to 6 inches long that is covered with a material of sufficient thickness to allow consistent measurement over a broad energy range. (The GM tube measures radiation from any direction and absorbed dose rates from beta-gamma radiation fields of energies greater than about 100 kilo-electron volts [keV]). Energies for cesium-137 are below:

E Maximum (KeV)	E Average (KeV)
511.6	156.8
1173.2	415.2

2.1. Limitations

GM counters have several characteristics that can lead to erroneous results unless the user is aware of them.

A. At high radiation levels, the counter will not recover from a count soon enough to measure the next entering particle. This causes a decreased response at higher radiation levels; at extremely high levels, the response may no longer increase with increased radiation. In certain cases, the response may decrease or go to zero at very high levels.

B. At extreme temperatures, the instrument may respond erratically or not at all. Under these conditions, a check source is needed to ensure reliable behavior.

C. The GM tube is delicate and sensitive to damage if dropped or exposed to significant changes in air pressure. If a rattling sound is heard when the user blows air across the probe face, it is likely that the tube has broken. To avoid a common means of tube breakage, do not ship the probe in an unpressurized airplane.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should

be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	Sop Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination
6.11	Beta-Gamma Radiation Measurements Using a Geiger-Müller Detector

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP and SOPs listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the current calibration of the probe and the ratemeter/scaler.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check and calibration in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

3.2.3. Field

A. Take five, 1-min background counts to ensure that the probe is not contaminated and to determine contamination criteria. If the count rate is greater than normal, check for surface contamination and be sure that the high-voltage setting is as marked on the probe. Calculate the mean background, the standard deviation of the mean, and three times the standard deviation as shown below.

$$X = (x1 + x2 + x3 \ldots + xn) / N$$

where

X = the mean

N = number of samples

x1+x2+x3...xn = summation of count results for all background counts measured

SDX = standard deviation of the mean = $(X/N)^{1/2}$

3SDX = $3(X/N)^{1/2}$ = contamination criterion

B. Take a 1-min count using a check source (like Tc-99) to check instrument response. The efficiency of the Ludlum 44-9 is typically about 15%.

Efficiency = net counts per minute/source disintegrations per minute

3.3. Operation

3.3.1. Obtaining Measurements

A. Record beta-gamma measurements with the GM detector on the Beta-Gamma Measurements form (Appendix 5.2). Complete the form according to Appendix 5.3, Data Form Completion.

B. Place the GM probe at a small distance (one-half inch) from the location to be monitored.

NOTE: The thin window of the probe is easily punctured. Care should be taken to protect the surface from sharp objects.

C. Take a count of predetermined duration (0.5 min to 2 min) and record the count rate.

D. If using an energy-compensated GM, multiply the count rate by the calibration factor and determine the beta-gamma dose rate in millirads/hour (mrad/hr).

E. Compare the counts to the contamination criteria. The FSP or WP may require further characterization of samples or locations exceeding these criteria. Samples or locations with counts greater than 3SDX are considered contaminated.

3.4. Postoperation

3.4.1. Field

A. Turn all switches to the off position.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. If necessary, make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Ensure that all radiological sources and standards have been stored in a locked area.

C. Inventory equipment and supplies. Repair or replace all broken or damaged items. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunctions or damage.

4. SOURCE

Healy, J. W. 1970. "Los Alamos Handbook of Radiation Monitoring." Los Alamos Scientific Laboratory report LA-4400. Los Alamos, New Mexico.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Beta-Gamma Measurements Form

5.3. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ GM pancake probe (Ludlum 44-9 or the equivalent)

_____ Ratemeter/scaler (Ludlum 2220 or the equivalent)

_____ Energy-compensated GM (Ludlum 44-38 or the equivalent)

_____ Cable

_____ Beta source (TC-99 or Sr-90)

APPENDIX 5.2

BETA-GAMMA MEASUREMENTS FORM

BETA–GAMMA MEASUREMENTS

PAGE 1 OF _____

FACILITY CODE _____ LOG DATE _____

LOGGER CODE _____ FIELD REP _____

RATEMETER/SCALER: ACCEPTANCE CODE _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

VOLTAGE _____ BATTERY _____

GM PROBE:

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

AVERAGE BACKGROUND CPM _____ + 3 STANDARD DEVIATIONS = $3(\frac{\bar{X}}{N})^{1/2}$ = _____

SOURCE CHECK DATE/TIME _____

WINDOW OPEN (O) OR WINDOW CLOSED (C) _____

CALIBRATION FACTOR _____ (mrad/hr)/CPM

COMMENTS _____

LOC ID	COORDINATES (FT)		SAMPLE ID OR ITEM DESCRIPTION	COUNTS	COUNT TIME	CPM	mrad/hr	ABOVE CRITERIA (YES/NO)
	NORTH	EAST						

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
BGM–121 (3/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

BETA-GAMMA MEASUREMENTS FORM

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date that information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Rep. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

7. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

8. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

9. Voltage. The voltage that is applied to the detector. For a pancake Geiger-Müller (GM), this is usually about 900 volts.

10. Battery. The battery voltage reading at the beginning of the measurement.

11. GM Probe Model No. The model number of the GM probe.

12. GM Probe Serial No. The serial number of the GM probe.

13. GM Probe Calibration Date. The date when the GM probe was last calibrated.

14. Average Background cpm + 3 Standard Deviations. This field is used to establish contamination criteria for use in sample selection for analyses or general screening.

$$\text{Average background} = X = (x1+x2+x3+\ldots Xn) / N$$

where

x1,x2, x3...xn = a summation of all the background counts obtained

N = the total number of background counts taken

3 standard deviations = 3SDX = 3(X/N)1/2

15. Source Check Date/Time. The date and time the system was last source checked.

16. Window Open (O) or Window Closed (C). When using an energy-compensated GM, the window can be open or closed as specified in the site Health and Safety Plan. Enter N/A if using a pancake GM.

17. Calibration Factor. The calibration factor in millirads per hour (mrad/hr)/counts per minute (cpm) used to convert cpm to mrad/hr when using an energy-compensated GM. Enter N/A if using a pancake GM.

18. Comments. Any additional information.

19. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

20. Coordinates (Ft). The coordinates of the measurement location in feet. The format is north and east.

21. Sample ID or Item Description. The sample identification number or description of the item being counted. Enter N/A if not applicable.

22. Counts. The counts obtained over the counting period. Enter N/A if using a ratemeter.

23. Count Time. The time in minutes over which the counts were collected. Enter N/A if using a ratemeter.

24. CPM. The counts per minute obtained by dividing the total counts by the counting time or by recording the ratemeter cpm reading.

25. mrad/hr. The dose rate obtained using a calibration factor applied to an energy-compensated GM.

26. Above Criteria (Yes/No). If the counts obtained are greater than the average background + 3 standard deviations, the item or location is considered contaminated (yes). If the counts are below this criterion, the item or location is not considered contaminated (no).

STANDARD OPERATING PROCEDURE 6.15

MEASUREMENT OF GAMMA-RAY FIELDS USING A SODIUM IODIDE (NaI) DETECTOR

1. PURPOSE

To describe the procedure for making count-rate measurements of a gamma-ray field with a sodium iodide (NaI) detector.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of a given operation, related health and safety requirements, and the applicability of this procedure to the activities.

Gamma radiation field strengths may be used to indicate contamination by gamma emitters. Elevated count-rate data must be carefully interpreted because uncontaminated areas can demonstrate high readings if they are next to an area contaminated with gamma emitters.

Using this procedure, it is possible to identify area or point sources of gamma-emitting radionuclides and determine whether an observed reading is due to shine from an adjacent source. These techniques are outlined in Sections 3.3.2 and 3.3.3. It should be noted that these are considered gross screening techniques only, rather than determinate measures.

Count-rate data from a sodium iodide (NaI) detector can be converted to exposure rate (μR/hr) measurements if the detector has been correlated with a calibrated, pressurized ionization chamber (PIC). See SOP 6.9, Correlation of a Sodium Iodide Detector to the Pressurized Ionization Chamber.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

6.9 Exposure Rate Measurements Using a Pressurized Ionization Chamber

6.10 Correlation of a Sodium Iodide Detector to the Pressurized Ionization Chamber

3.2. **Preparation**

3.2.1. **Office**

A. Review the FSP or WP and SOPS listed in Section 3.1.

B. Coordinate schedules/actions with the installation staff.

C. Obtain appropriate permission for property access.

D. Assemble the equipment and supplies listed in Appendix 5.1. Ensure the proper operation of all field equipment. Ensure current calibration of the probe and the ratemeter/scaler.

E. Obtain PIC correlation data if these have been determined for the surveyed area.

3.2.2. **Documentation**

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check and calibration in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of codes and location IDs used in the completion of data forms.

3.2.3. **Field**

A. Visually inspect the equipment, including the connector cable, for breakage.

B. Check the battery charge. If necessary, replace the batteries.

C. Set the threshold to the value given on the calibration sticker (usually 100 volts).

D. Set the detector voltage to the value given on the calibration sticker. The operating voltage for an NaI probe is usually 700 to 1000 volts.

E. Set the window to the out position (gross mode).

F. Note the response of the detector to the check source.

3.3. Operation

3.3.1. Count-Rate Measurements

A. Record the gamma count-rate measurements taken with the NaI detector on the Gamma Ray Count-Rate Data form (Appendix 5.2). Instructions to complete the form are in Appendix 5.4.

B. Turn on the instrument.

C. Hold the detector first at a height of 3 ft above the ground (waist height), then at the ground surface if an above-background level is noted. Allow the ratemeter/scaler to integrate the count rate for at least 10 sec.

D. Record the results on the Gamma Ray Count-Rate Data form.

3.3.2. Recognizing Area and Point Sources

A. Walk slowly in the area of interest, holding the NaI detector waist high and note the count rate. Determine the location of the highest observed gamma count rate (sometimes called the HOG).

B. At the HOG, compare the count rate obtained at waist height with the count rate obtained at ground level. If both count rates are above background and increase rapidly as the detector is held closer to the ground surface, the anomalous area may be an isolated hot spot with an area of only a few square feet. If the HOG is broad in extent and there is no difference in the count rate at ground level and waist height, the anomalous area probably is not highly localized.

3.3.3. Recognizing Gamma Shine from Nearby Anomalies

Walk slowly in the area of interest, holding the NaI detector at waist height. If the count rate increases while leaving the area of interest, some of the gamma count rate observed at the area of interest may be due to shine from an adjacent gamma source. If the count rate increases as the height of the detector above the ground increases, some of the gamma count rate at the area of interest may be due to shine.

3.4. Postoperation

3.4.1. Field

A. Turn all switches to the off position.

B. Ensure that all equipment is accounted for, decontaminated (see SOP 1.6, General Equipment Decontamination), and ready for shipment.

C. If necessary, make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

3.4.2. Documentation

A. Record any uncompleted work (like additional monitoring) in the logbook.

B. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

C. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return all field equipment to the equipment manager and identify any operational problems from previous use.

C. Ensure that all radiological sources and standards have been stored in a locked area.

4. SOURCE

Ludlum. 1982. "Instruction Manual Model 2220 Portable Scaler Ratemeter." Ludlum Measurements, Inc. April 1982. Sweetwater, Texas.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Gamma Ray Count-Rate Data Form

5.3. Data Form Completion

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ Portable ratemeter/scaler, Ludlum 2220 (or equivalent)

_____ Sodium iodide (NaI) gamma scintillometer, Ludlum 44-10 (or equivalent)

_____ D-cell batteries (4)

_____ Connector cable

_____ Hand-held calculator

_____ Gamma check source

APPENDIX 5.2

GAMMA RAY COUNT-RATE DATA FORM

GAMMA RAY COUNT–RATE DATA
(USING SCINTILLOMETER)

PAGE 1 OF ___

FACILITY CODE _____ FIELD REP _____

LOGGER CODE _____ **LOG DATE** _____

ACCEPTANCE CODE _____ SITE AREA CORRELATION NO _____

RATEMETER/SCALER MANUFACTURER _____ VOLTAGE _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

WINDOW OUT THRESHOLD _____ BATTERY _____

PROBE MANUFACTURER _____

MODEL NO _____ SERIAL NO _____ CALIBRATION DATE _____

SOURCE CHECK DATE/TIME _____

LOCATION ID	**COORDINATES (FT)**		METER READING (CPM)		EXPOSURE RATE (μ R/hr)	
	NORTH	**EAST**	SURFACE	3 FT	SURFACE	3 FT

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
SED–100 (2/88)

FORM COMPLETED BY/DATE _____ TECHNICAL REVIEWER/DATE _____

GAMMA RAY COUNT-RATE DATA

(USING SCINTILLOMETER)

PAGE ___ OF ___

FACILITY CODE _____ FIELD REP _____

LOGGER CODE _____ LOG DATE _____

LOCATION ID	COORDINATES (FT)		METER READING (CPM)		EXPOSURE RATE (μ R/hr)	
	NORTH	EAST	SURFACE	3 FT	SURFACE	3 FT

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
SED-100 (3/88)

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Field Rep. The name of the field representative.

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Log Date. The date that information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

5. Acceptance Code. One-character code assigned by the site manager.

6. Site Area Correlation No. The number assigned to the PIC scintillometer correlation data set by the site health and safety coordinator.

7. Ratemeter/Scaler Manufacturer. The manufacturer of the ratemeter/scaler in use.

8. Voltage. The voltage that is applied to the detector. The voltage value is set to the value given on the calibration sticker.

9. Ratemeter/Scaler Model No. The model number of the ratemeter/scaler.

10. Ratemeter/Scaler Serial No. The serial number of the ratemeter/scaler.

11. Ratemeter/Scaler Calibration Date. The date when the ratemeter/scaler was last calibrated.

12. Window. The window will be in the out position unless otherwise specified.

13. Threshold. The adjustment for the lower energy level of the discriminator. The threshold value is set to the value shown on the calibration sticker.

14. Battery. The battery charge reading at the beginning of the measurement.

15. Probe Manufacturer. The manufacturer of the sodium iodide (NaI) probe.

16. Probe Model No. The model number of the NaI probe.

17. Probe Serial No. The serial number of the NaI probe.

18. Probe Calibration Date. The date when the NaI probe was last calibrated.

19. Source Check Date/Time. The date and time that the detector response to a gamma source was last checked.

20. Location ID. Four-character code assigned sequentially to each borehole, test pit, or surface location where physical, chemical, biological, radiological, and other measurements are taken.

21. Coordinates (Ft). The coordinates of the measurement location in feet. The format is north and east.

22. Meter Reading (CPM). The count rate in counts per minute. There are two fields. One field is for readings at ground level, and the other is for readings at 3 ft above the ground.

23. Exposure Rate. The exposure rate in microR/hour (μR/hr). In order to make entries into these fields, it is necessary to determine the count rate to exposure rate conversion factor for the area of the site under investigation. A calibrated microR meter can also be used for entries in these fields. One field is for readings at ground level, and the other is for readings at 3 ft above the ground.

STANDARD OPERATING PROCEDURE 6.16

HEAT STRESS MONITORING

1. PURPOSE

To outline the procedure for monitoring heat stress and other measures for protecting workers from heat exhaustion and heat stroke in warm environments.

2. DISCUSSION

The Field Sampling Plan (FSP) or Work Plan (WP) provides information on the scope of a given operation, related health and safety requirements, and the applicability of this procedure to the activities.

Heat stress is often the major hazard facing workers at hazardous waste sites, especially when respirators and clothing that is semipermeable (Tyvek coveralls) or impermeable are worn in warm or hot weather. Although monitoring heat stress is an important factor in preventing heat-related injuries, the proper planning, budgeting, and scheduling of site activities are equally important. In addition to monitoring heat stress, heat-stress problems can be mitigated by employing some of the measures described below.

- Have workers drink plenty of fluids.
- Provide shade.
- Schedule work in the early morning, evening hours, or at night.
- Schedule work during the cool part of the year.
- Provide workers with cooling vests.
- Provide workers with a cool-down room in the contaminated zone next to the area in which they are working.
- Set up a tent and refrigerate the work area.
- Have two or more crews work on alternate shifts. One or more crews can cool down, while the other crew works in the heat.

3. PROCEDURE

3.1. Associated Procedures

Information that applies to most field activities is provided in SOPs 1.1-1.10. In addition to the FSP or WP, those SOPs provide guidance that may supplement the information in this procedure. They should be consulted as necessary to obtain specific information about equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements. Procedures directly associated with this SOP are listed below.

SOP No.	SOP Title
1.1	General Instructions for Field Personnel
1.6	General Equipment Decontamination

3.2. Preparation

3.2.1. Office

A. Review the FSP or WP, the SOPs listed in Section 3.1, and the Health and Safety Plan.

B. Obtain and confirm the accurate operation of field equipment listed in Appendix 5.1.

3.2.2. Documentation

A. Obtain a logbook from the QA officer.

B. Record results of the equipment check in the logbook.

C. Obtain a sufficient number of the appropriate ER Program data collection forms (see INDEX TO SOPs).

D. Consult the ER Program data administrator for a current list of codes used in the completion of data forms.

3.2.3. Field

A. Place a thermometer in a shaded location of the work area to measure the ambient air temperature.

B. As described in Appendix 5.3, Data Form Completion, record the time, temperature, and personnel baseline pulse rates and indicate whether the day is cloudy or sunny on the Heat Stress Monitoring Record form (Appendix 5.2).

C. Calculate the adjusted air temperature as shown below.

$$\text{ta adj } F^\circ = \text{ta } F^\circ + [13 \times (\%\ \text{sunshine}/100)]$$

where

ta F° = the temperature indicated on the thermometer in F°

3.3. Operation

3.3.1 Monitoring Heat Stress

A. Complete the Heat Stress Monitoring Record form by following instructions in Appendix 5.3.

B. Record baseline data obtained in Section 3.2.3.B. and set the timer for the period of time indicated on the National Institute of Safety and Health (NIOSH) Heat Stress Monitoring Table (Appendix 5.4).

C. When the working time has elapsed, have workers find their own pulse and count the number of times their heart beats in 15 or 30 sec. Convert pulse rates to beats per minute (bpm) and record the time and weather conditions on the Heat Stress Monitoring Record form.

D. Have the workers take a break in the shade (or cooler room) until their pulse rates drop to a value close to their baseline rates. This length of time will vary with site-specific conditions.

1. If no crew member had a pulse rate that was above 110 bpm at the beginning of the break, continue following the suggested work durations shown in Appendix 5.4.

2. If a crew member had a pulse rate above 110 bpm, the next work period should be two-thirds as long as the previous work period.

EXAMPLE: It is 80°F in the shade. There is no cloud cover, and the crew is working in impermeable clothing. The effective temperature would be 93°F, and the table in Appendix 5.4 suggests a 15-min work period. If a worker had a pulse rate above 110 bpm at the beginning of a break, the next work period should be 10 min long. If hot weather conditions remain unchanged and a worker had a pulse rate above 110 bpm at the beginning of the next break, then the third work period should be shortened to 6 and 2/3 min.

E. Identify heat-sensitive workers and assign some of their duties to individuals with a lower sensitivity to heat.

F. Take appropriate action if you observe any of the early signs of heat stress listed below.

1. Clumsiness or lack of coordination

2. Mental confusion or poor judgment

3. Frequent bending over or leaning against objects

4. Going to unusual lengths to get out of sun

5. Workers who claim that they are not too hot when demonstrating one or more of these symptoms

G. Be prepared to give first aid and transport workers suffering from severe heat stress or heat stroke to medical facilities.

3.4. Postoperation

3.4.1. Field

Ensure that all equipment is accounted for and decontaminated (see SOP 5.6, General Equipment Decontamination).

3.4.2. Documentation

A. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

B. Review data collection forms for completeness.

3.4.3. Office

A. Deliver original forms and logbooks to the document control officer (with copies to the site manager and files) for eventual delivery to the Department of Energy.

B. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

4. SOURCES

American Red Cross. 1979. Standard First Aid and Personal Safety. 2d ed. Garden City, New York: Doubleday and Company, Inc.

NIOSH. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." U.S. Department of Health and Human Services, Center for Disease Control, National Institute for Occupational Safety and Health, Atlanta, Georgia.

5. APPENDIXES

5.1. Equipment and Supplies Checklist

5.2. Heat Stress Monitoring Record Form

5.3. Data Form Completion

5.4. NIOSH Heat Stress Monitoring Table

APPENDIX 5.1

EQUIPMENT AND SUPPLIES CHECKLIST

_____ 60-min timer

_____ Stopwatch

_____ Thermometer

APPENDIX 5.2

HEAT STRESS MONITORING RECORD

HEAT STRESS MONITORING RECORD

FACILITY CODE _____ **LOG DATE** _____

LOGGER CODE _____ FIELD REP _____

ACCEPTANCE CODE _____

WORKER NO 1 NAME AND SS NO _____

WORKER NO 2 NAME AND SS NO _____

WORKER NO 3 NAME AND SS NO _____

WORKER NO 4 NAME AND SS NO _____

WORKER NO 5 NAME AND SS NO _____

TIME (HH:MM)	AIR TEMP	% SUNSHINE	ADJ TEMP (°F)	ACTIVITY CODE	PULSE RATE OF WORKER (BEATS PER MINUTE)				
					WORKER 1	WORKER 2	WORKER 3	WORKER 4	WORKER 5

ACCEPTANCE CODES: A–ACCEPTABLE R–RECONNAISSANCE U–UNACCEPTABLE N–NOT DETERMINED

ACTIVITY CODES: BL – BASELINE W – WELL SAMPLING D – DRILLING O – OTHER (SPECIFY)
M – SURFACE MEASUREMENTS BR – BREAK T – TEST PITTING S – SURFACE SAMPLING Z – OBSERVING

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS

HSM-105 (1/88)

_____ FORM COMPLETED BY/DATE

_____ TECHNICAL REVIEWER/DATE

APPENDIX 5.3

DATA FORM COMPLETION

Use a pen with black ink that is not water soluble (not a felt-tip pen). Make an entry in each blank. Where there is no data entry, enter UNK for Unknown, NA for Not Applicable, or ND for Not Done. If any procedure was not performed as prescribed, give the reason for the change or omission on the form. To change an entry, draw a single line through it, add the correct information above it, and initial the change.

HEAT STRESS MONITORING RECORD

1. Facility Code. Five-character code abbreviating the facility name where program activity is being conducted. The first three characters indicate the facility, and the remaining two numbers designate the specific site within the facility.

2. Log Date. The date that information recorded on the form was obtained in the format DD-MMM-YY (01-JAN-88).

3. Logger Code. Three-character or four-character code identifying the company responsible for collecting the information recorded on the form.

4. Field Representative. The name of the field representative.

5. Acceptance Code. One-character code assigned by the site manager.

6. Worker Name and SS No. Name(s) and social security number(s) of the worker(s).

7. Time (HH:MM). The 24-hr clock (see conversion table below) will be used.

Conversion Table

Conventional Time	24-Hr Time
1:00 a.m.	1:00
12:00 noon	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00
5:00 p.m.	17:00
6:00 p.m.	18:00
7:00 p.m.	19:00
8:00 p.m.	20:00
9:00 p.m.	21:00
10:00 p.m.	22:00
11:00 p.m.	23:00
12:00 midnight	24:00

8. Air Temperature. The air temperature (°F) measured in the shade.

9. % Sunshine. If cloudy, enter a 0; if sunny, enter 100. If partly cloudy, enter 50.

10. Adj. Temp (°F). The adjusted temperature in °F determined by the formula below.

$$\text{ta adj } F^\circ = \text{ta } F^\circ\ [13 \times (\%\ \text{sunshine}/100)]$$

11. Activity Code. Code describing ongoing activity.

Activity Code Table

Activity	Code
Baseline	BL
Break	BR
Drilling	DR
Grouting	GR
Logging	LO
Measurements	ME
Sampling	SA
End of Break	EB

12. Pulse Rate of Worker (Beats per minute). Pulse rate is measured in beats per minute.

APPENDIX 5.4

NIOSH HEAT STRESS MONITORING TABLE[a]

ADJUSTED TEMPERATURE[b]	NORMAL WORK EMSEMBLE[c]	IMPERMEABLE ENSEMBLE
90°F(32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F(30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F(28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.°F(25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Source: Reference [13]

[a]For work levels of 250 kilocalories/hour.

[b]Calculate the adjusted air temperature (ta adj) by using this equation: ta adj F° = ta. F° + [13 x (% sunshine/100)]. Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percentage of sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow 0 percent sunshine = no shadows).

[c]A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

ATTACHMENT 1

FIELD OPERATING PROCEDURES (FLDs)

2.4.1 Noise Protection - FLD01

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD01 - Noise Protection

Noise is defined as unwanted sound. Noise can cause sudden traumatic hearing loss, long-term more slowly occurring sensory-neural hearing loss which is irreversible, disruption of communication and masking of warning devices and alarms, and increased stress levels and effects on the cardio-vascular and nervous systems. These latter two effects may occur at levels below that which cause damage to hearing and in situations where the conditions are more or less constant and daily.

OSHA regulations generally apply to 8-hour exposures, and consider 85 dBA as an action level for a Hearing Conservation Program.

Where feasible, noise exposure will be controlled by engineering controls. Where high noise levels are encountered and where engineering controls are infeasible or until engineering controls can be accomplished, hearing protection devices will be used for worker protection from noise-induced hearing loss.

Some of the sources of noise on hazardous materials, construction, and industrial sites of a magnitude to cause hearing damage are: compressor motors, drill rig engine, hammer blows (from split spoon or other), compressor motors, compressed air, compressed water, and heavy equipment. The list is not all inclusive.

Any sound level surveys indicating noise levels of 85 dBA or above, or, in the absence of sound level measuring instrumentation, any noise/sound preventing normal vocal discussion between two individuals at arms length distance will dictate the need for hearing protection.

Hearing protection will be afforded by either disposable ear plugs or ear muffs. Administrative time control is not an acceptable method for preventing noise exposure since extreme noise for a short duration can cause severe, permanent hearing loss.

In addition to these protocols, WESTON's Hearing Conservation Program includes physical examination and audiometric testing during annual medical monitoring.

The selection, use, maintenance, and control of hearing protection is further defined in the WESTON Personnel Protective Equipment Program.

2.4.2 Inclement Weather - FLD02

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD02 - Inclement Weather

2.4.2.1 Hazard

Hot weather (ambient temperatures over 70°F), cold weather (ambient temperature levels below 40°F), rain, snow, ice and lightning are examples of inclement weather that may be hazardous or add risk to WESTON work activities. Heat stress and cold stress are covered under separate Standard Procedures. Heat and cold stress must be identified as hazards in pre-project evaluations, and listed as such in site-specific HASPs with the Standard Procedures incorporated.

Heat, rain, cold, snow, ice, and lightning are also inclement weather conditions that represent hazards and increased risk of performing WESTON work activities.

Extremes of heat, cold and humidity, as well as rain, snow and ice, affect monitoring instrument response and reliability, respiratory protection performance, and chemical protective clothing materials.

Heat

Heat stress is addressed in separate WESTON Standard Procedures. Heat represents additional hazards and increased risks. Hot dry weather increases risk of soil drying, erosion and dust dispersion which may present or increase risk of exposure and environmental impact from toxic hazards. Hot weather will increase pressure on closed containers and the rate of volatilization, thereby potentially increasing the risk of exposure to toxic, flammable, or explosive atmospheres.

Rain, Wet Weather, and High Humidity

Rain and wet conditions increase slipping and tripping hazards, braking distances of vehicles, and chance of slippage of other braking devices on augurs, drills, etc. Rain fills holes, obscures trip and fall hazards, and increases risk of electrical shock when working with electrical equipment. Rain changes soil conditions in trenching and excavating activities forming quicksand, weakening walls, and increasing risk of cave-in. Vehicles become stuck in mud and tools slip on wet surfaces.

Cold, Snow, and Ice

In addition to cold stress, which is covered in a separate Standard Procedure, cold weather affects vehicle operation by causing window frosting, increased difficulty of starting and braking. Ice and snow accumulates on windows and obscures vision.

Cold weather causes icing of roadways, driveways, parking areas, general work places, ladders, stairs, and platforms that are wet.

Ice is not always as obvious as snow or rain and requires special attention.

Snow increases risk of slipping when walking, climbing steps and ladders, working at elevation and of accidents when driving vehicles or operating heavy equipment. Heavy snow may cause electric lines to sag or break, and use of electric equipment in snow increases risk of electric shock. Snow hides pot holes and mud, which can result in vehicles getting stuck or persons falling when stepping onto or into hidden holes. Snow also may cover water, drums or containers, and sharp metal or sticks that can cause falls or punctures.

Lightning

Lightning represents a hazard of electrical shock that is increased when working in flat open spaces, elevated work places, or working near tall structures or equipment such as stacks, radio towers, and drill rigs. Lightning has caused chemical storage tank fires.

2.4.2.2 Recognition and Risk Assessment

There are few actual OSHA rules to apply to the conditions covered in this procedure; however, under the "General Duty Clause," they must be addressed in safety programs.

Heat, rain, cold, snow, ice, and lightning are natural phenomena that complicate work activities, and add or increase risk. In the planning stages of a project and safety plan, these elements must be considered as physical hazards. Risk assessment can be accomplished in part in the development stages of a project, by listing in the HASP as possible, the most likely conditions, i.e., rain and lightning in late spring, summer, and early fall, or lightning prone areas; cold, snow, and ice in winter, etc., but the true determination of risk must often be made on-site by the Site Health and Safety Coordinator. It is important that the SHSC is alert to these hazards, does not take them simply as a matter of fact, and has time to notice them.

The few OSHA regulations that apply to inclement weather conditions include:

- Monitoring equipment and PPE must be maintained in proper working order and used according to manufacturers' instructions.

- Walkways, stairs, ladders, elevated workplaces, and scaffold platforms must be kept free of mud, ice, and snow.

- Vehicles used in rain or cold weather must have windshield wipers and defrosters with windows kept clear of obstruction.

- Equipment requiring "roll-over protection" must have seat belts.

- Containers of hazardous substance must be remotely opened if pressure is suspected.

- Employees must be protected from airborne contaminants using engineering controls such as wetting dry soil to prevent particle dispersion and providing local ventilation to reduce volatile air contaminants to safe levels, or if engineering controls are infeasible, using prescribed PPE.

Additional procedures for protection during inclement weather include:

- Required conformance with traffic laws, including maintaining speed within limits safe for weather conditions, and wearing seat belts at all times.

- Using a walking stick or probe to test footing ahead of persons walking where there is standing water, snow, or ice to protect the walker against stepping into pot holes or onto puncture hazards, buried containers, or other potential structurally unsound surfaces.

- Prior to using vehicles or equipment in off-road work, walking the work area or intended travel way when puddles or snow may obscure pot holes, puncture hazards or buried containers, or other potential structurally unsound surfaces.

- Arrange to have winches, come-alongs or other mechanical assistance available when vehicles work in areas where there is increased risk of getting stuck. Cable or rope and mechanical equipment used for pulling stuck vehicles must be designed for the purpose, of sufficient capacity for the load, and be inspected regularly and before use to ensure safety. **Manually pushing stuck vehicles is to be avoided.**

- Monitoring wind shifts and velocity where change may result in dispersion of airborne contaminants into work area.

- Prior to working in areas or beginning projects in times when there is an increased likelihood of lightning or that increase the potential for lightning striking personnel, steps must be taken to predict the occurrence of lightning strikes, including:

- Checking with client management to determine if there is any pattern or noted conditions that predict lightning or if there are structures that are prone to lightning strikes. Arrange for client notification when there is increased potential for lightning activities. Ensure that clients include WESTON workers in lightning contingency plans.

- Monitoring Weather Reports.

- Noting Weather Changes and conditions that produce lightning

- Stopping work in open areas, around drill rigs or other structures that may attract lightning, on or in water and in elevated work places when lightning strikes are sighted or thunder is heard near a work site.

Much of the responsibility for protection from inclement weather hazards falls upon the SHSC. The SHSC must recognize the inclement weather hazards affecting site for which he is responsible, and complete the pre-site activity risk assessment when inclement weather occurs. The SHSC must recognize which weather conditions affect instrument and PPE function, and constantly remind site workers of the effects and need for more careful attention to check out, donning and doffing, and monitoring of function and integrity. The SHSC must make decisions on the proper safety procedures to use if work must continue or to stop work if the risk is too great. **Corporate Health and Safety must be notified of all instances of need to stop work for safety reasons including inclement weather.**

2.4.5 Heat Stress Prevention and Monitoring - FLD05

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD05 - Heat Stress Prevention and Monitoring

Heat stress may occur at any time work is being performed at elevated temperatures. Wearing of chemical protective clothing, which may result in decreasing natural body heat loss, increases the risk of heat stress.

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur, with systems ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal. Because heat stress is one of the most common and potentially serious illnesses at hazardous waste sites, regular monitoring and other preventative measures are vital.

Site workers must learn to recognize and treat the various forms of heat stress. The best approach is preventative heat stress management. In general:

- Have workers drink 16 ounces of water before beginning work, such as in the morning or after lunch. Provide disposable 4-ounce cups, and water that is maintained at 50 - 60°F. Urge workers to drink 1 to 2 of these cups of water every 20 minutes for a total of 1 to 2 gallons per day. Provide a cool area for rest breaks. Discourage the intake of coffee during working hours. Monitor for signs of heat stress.
- Acclimate workers to site work conditions by slowly increasing workloads, i.e., do not begin site work activities with extremely demanding activities.
- Provide cooling devices to aid natural body heat regulation. These devices, however, add weight and their use should be balanced against worker efficiency. An example of a cooling aid is long cotton underwear, which acts as a wick to absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing.
- In extremely hot weather, conduct field activities in the early morning and evening.
- Ensure that adequate shelter is available to protect personnel against heat as well as cold, rain, snow, etc., which can decrease physical efficiency and increase the probability of both heat and cold stress. If possible, set up the command post in the shade.

- In hot weather, rotate shifts of workers wearing impervious clothing.
- Good hygienic standards must be maintained by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

The following is a discussion of specific results of heat stress.

2.4.5.1 Heat Stroke

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

- Symptoms - Red, hot, dry skin, although a person may have been sweating earlier; nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rate; unconsciousness or coma.
- Treatment - Cool the victim quickly. If the body temperature is not brought down fast, permanent brain damage or death will result. Soak the victim in cool, but not cold water; sponge the body with cool water or pour water on the body to reduce the temperature to a safe level (102°F). Observe the victim and obtain medical help. Do not give coffee, tea, or alcoholic beverages.

2.4.5.2 Heat Exhaustion

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

- Symptoms - Pale, clammy, moist skin; profuse perspiration and extreme weakness. Body temperature is normal, pulse is weak and rapid, and breathing is shallow. The person may have a headache, may vomit, and may be dizzy.
- Treatment - Remove the person to a cool, air conditioned place, loosen clothing, place in a head-low position, and provide bed rest. Consult physician, especially in severe cases. The normal thirst mechanism is not sensitive enough to ensure body fluid replacement. Have patient drink 1 to 2 cups of water immediately, and every 20 minutes thereafter until symptoms subside. Total water consumption should be about 1 to 2 gallons per day.

2.4.5.3 Heat Cramps

Heat cramps are caused by perspiration that is not balanced by adequate fluid intake. Heat cramps are often the first sign of a condition that can lead to heat stroke.

- Symptoms - Acute painful spasms of voluntary muscles, e.g., abdomen and extremities.

- Treatment - Remove victim to a cool area and loosen clothing. Have patient drink 1 to 2 cups of water immediately, and every 20 minutes thereafter until symptoms subside. Total water consumption should be 1 to 2 gallons per day. Electrolyte supplements can enhance recovery (i.e., Gatorade, Quench, etc.).

2.4.5.4 Heat Rash

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

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

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

2.4.5.5 Heat Stress Monitoring and Work Cycle Management

For strenuous field activities that are part of on-going site work activities in hot weather, the following procedures shall be used to monitor the body's physiological response to heat, and to manage the work cycle, even if workers are not wearing impervious clothing. These procedures are to be instituted when the temperature exceeds 70°F.

- Measure Heart Rate - Heart rate should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 33%, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute 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 beats/minute.

- Measure Body Temperature - When ambient temperatures are over 90°, body temperatures should be measured with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period 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 shall be used as a guideline:

Temperature	(Level D)	(Level C)
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F (28.1°-32.2°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-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
50% sunshine	=	50% cloud cover	=	0.5
0% sunshine	=	full cloud cover	=	0.0

Adjusted temp. = actual temp. + 13 X (% sunshine factor).

The length of work period is governed by Frequency of Physiological Monitoring. 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 beats/minute at the beginning of the rest period, that individual will remain on rest-time until his/her heart rate drops well below 110 beats/minute and their next work period (=duration of time before suggested physiological monitoring) is decreased by 33%.

2.4.6 Cold Stress - FLD06

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD06 - 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 causes severe injury to the surface of the body, or results in profound generalized cooling, ultimately causing death. Areas of the body that have high surface area-to-volume ratios such as fingers, toes, and ears, are the most susceptible.

Chemical protective clothing generally does not afford protection against cold stress. In many instances, it increases susceptibility. Chemical hazard site workers must learn to dress carefully to provide chemical protection and thermal insulation while not dressing so warmly that exercise or strenuous activity will result in heat stress.

Provisions must also be made for the fact that, after physical activity and accumulation of body heat, sudden chilling during decontamination and rest breaks may increase susceptibility to colds, etc.

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind Chill Indices describe the chilling effect of moving air in combination with low temperature.

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

2.4.6.1 Frostbite

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

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

To administer first aid for frostbite:

- Take the victim indoors and rewarm the areas quickly in water that is between 39°C and 41°C (102°F-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.
- Then elevate the injured area and protect it from injury.
- Do not allow blisters to be broken.
- Use sterile, soft, dry material to cover the injured areas.
- Keep victim warm and get immediate medical care.

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

2.4.6.2 <u>Hypothermia</u>

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

- Shivering.
- Apathy, listlessness, and sleepiness.
- (Sometimes) rapid cooling of the body to less than 95°F.
- Unconsciousness, glassy stare, slow pulse, slow respiration.
- Death.

If hypothermia is suspected in any field personnel, move person to a warmer location until symptoms recede.

2.4.7 Wet Feet - FLD07

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD07 - Wet Feet

Under both hot and cold conditions, wet feet can lead to serious problems. Trench foot, paddy foot and immersion foot are foot ailments resulting from feet being wet for long periods of time and are similar in effect. In their more serious form, these ailments can result in pain, skin loss, and incapacitation.

Workers in wet conditions or when conditions result in sweating and feet become and remain wet must dry their feet and change socks regularly to avoid these ailments.

2.4.10 Manual Lifting and Handling of Heavy Objects - FLD10

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD10 - Manual Lifting and Handling of Heavy Objects

2.4.10.1 Hazard

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.

Cuts, Pinching, and Crushing

Splinters, slivers, and sharp edges on objects to be lifted can result in cuts. Heavy objects can pinch or crush fingers, toes, arms, and legs between the object and nearby objects, i.e., walls, tables, counters, railings, and obstructions. Insects or other biological hazards on or under objects to be lifted can result in bites or scratches. Contamination of objects can lead to chemical or radioactive materials exposure.

Muscle and Joint Injuries

Muscle and joint injuries occur when objects to be lifted are too heavy or awkward, in restricted access areas, or are lifted improperly.

Lifting tasks, which are awkward and repetitive, involving even light objects can lead to nerve and joint damage.

2.4.10.2 Recognition and Hazard Assessment

The need for manual lifting must be identified as a physical hazard when project tasks specifically require manual handling or use of heavy equipment, and the following safe lifting techniques, must be instituted:

- Plan any lifting task, noting:
  - Contact hazards - Check each object before lifting for presence of splinters, slivers, sharp edges or parts, cracks and loose joints, signs of biological hazards, and chemical or radioactive material contamination.
  - Weight of object - Unless involved in weight training, recommended safe lifting weights for an average man or woman are 50 and 35 pounds respectively.

- Size and shape of object - Large and oddly shaped objects are more difficult to lift, even within safe weight limits, due to imbalanced center of gravity.
- Area in which lifting is to be done - Check for pinch points such as other objects close by and that there is room for safe lifting.
- Conditions under which lifting is to be accomplished - Check for wet or slippery surfaces. Also consider level of protection to be used and that Level B or A protection may add up to 40 lb to be lifted as well as restricting range of motion and adding to area restriction by increasing bulk.
- Route to be traveled if lifting involves carrying - Check walking and working surfaces for slip and trip hazards, note ramps, changes on level of elevation, and ladders or stairways that need to be negotiated.

2.4.10.3 Prevention and Protection Programs

- Identify the potential for contact hazards on objects to be lifted before lifting. Check each object before lifting, remove any noted hazards as feasible, wear gloves (at a minimum cotton), leather or kevlar, chemical resistant, etc., depending on the nature of the hazard. Also wear safety boots, coveralls and chemical protection as appropriate.

- Avoid contact with cracks or loose joints or cover if hands or body can come into contact to reduce hazards of pinching.

- Workers must know their lifting limitations, plan lifting, keep themselves reasonably in shape and get help if uncertain that they can lift safely, and, Managers must plan and allow for safe lifting. **Safe lifting takes time.**

- 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 which must be negotiated.

• To lift objects which are square or rectangular in shape or form:

  - 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 back bone 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 & the surface on which the object is set.

This system, at first feels and seems awkward. Workers must be trained and have the opportunity to use the system with lighter objects before performing heavy lifting. **For other shaped objects, the only modification needed should be hand hold position.** When two or more persons are lifting, have a plan and a set of signals so lifting occurs simultaneously.

Do not carry objects in a manner which obstruct vision in line of travel and of feet and footing.

Carry objects so one hand is free for travel on stairs or there is unobstructed view of footing and two hands are free for travel on ladders.

2.4.10.5 Manual Handling of Heavy Objects

Hazard

Manual maneuvering or handling of heavy objects without actually lifting is often required on hazardous materials, RCRA facilities, and construction sites. This often involves moving drums or other containers. Manual handling of heavy objects, even when not actually lifting, can pose all of the hazards of lifting including, cuts, pinches, bruises, crushing, muscle and joint strain, and hazardous material and biological hazard contact.

Recognition and Risk Assessment

The need for manual handling of heavy objects must be addressed in the planning stages of a project HASP. Drums and other containers which must be maneuvered, for access to information or sampling locations, that are inaccessible to mechanical handling equipment, require manual handling and special precautions. When handling of heavy objects does not actually involve lifting, workers can handle heavier objects, even those weighing several hundred pounds, safely if proper techniques are used. In many instances, the procedures involve balancing and taking advantage of the shape of the object.

Prevention and Protection Programs

Prior to performing manual handling, it must be determined that it can be done safely and that mechanical assistance is infeasible.

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 risk of heavy items falling, hazardous materials contact and sharp edges, splinters or slivers increases.

Workers must be aware of their handling capacities and work within their capacities.

Objects to be manually handled must be checked prior to beginning movement for contact hazards and ensure handling will not trap hands, arms, legs, or feet between the object and other objects, walls, or railings.

Properly trained personnel may roll round or cylindrical objects if rolling will not damage the structural integrity. Rolling must be controlled by chutes, tag-lines, or other means of limiting acceleration. Workers must not be positioned down hill from rolled objects. Use of the legs for pushing and tag-line control of rolled objects must be stressed.

Only properly trained, personnel may move cylindrical objects which must remain upright by hand. Cylindrical objects, such as drums that must remain upright, are handled manually by slightly 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, pot holes, or other obstructions that could cause the object to snag, tip, or get out of control.

Flat, square, or rectangular objects are most easily handled using make-shift rollers or skids to break the friction with the resting surface and pushing, using the legs.

2.4.22 Heavy Equipment Operation - General - FLD22A

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD22A - Heavy Equipment Operation - General

Related SPOP: FLD23 - Cranes/Lifting Equipment
FLD24 - Aerial Lifts/Manlifts
FLD34 - Utilities
FLD35A - Electrical Safety - General
FLD35B - Electrical Safety - High Voltage

2.4.22.1 Machinery and Mechanized Equipment Safety

A. General

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 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 that the brakes and operating systems are in proper working condition.

Preventative 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.

Inspections or determinations of road conditions and structures will be made in advance to ensure that clearances and load capacities are safe for the passing or placing of any machinery or equipment.

Machinery and mechanized equipment will be operated only by designated personnel. Equipment deficiencies observed at any time that affect their safe operation will be corrected before continuing operation.

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.

A. General (Continued)

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

All machinery or equipment will be shut down and positive means taken to prevent its operation while repairs or manual lubrications are being done. Exemption:

Equipment designed to be serviced while running.

All repairs on machinery or equipment 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.

Stationary machinery and equipment will be placed on a firm foundation and secured before being operated.

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

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

Mechanized 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.

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

Persons will not be permitted to get between a towed and towing piece of equipment until the towing equipment has been stopped.

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.

A. General (Continued)

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.

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.

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.

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 or pass under the buckets or booms of loaders in operation.

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

2.4.23 Heavy Equipment Operation - Drill Rigs - FLD22B

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD22B - Heavy Equipment Operation - Drill Rigs

Related SPOP:
- FLD23 - Cranes/Lifting Equipment
- FLD24 - Aerial Lifts/Manlifts
- FLD34 - Utilities
- FLD35A - Electrical Safety - General
- FLD35B - Electrical Safety - High Voltage

WESTON will use the Drilling Safety Guide prepared by delegations of the Diamond Core Drilling Manufacturers Association and the National Drilling Contractors Association as published by the National Drilling Federation as the basic Safety Programs for all activities involving drill rigs or similar apparatus for the purpose of well installation or soil borings.

Copies of this document are available from Corporate Health and Safety.

2.4.34 Excavating/Trenching - FLD28

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD28 - Excavating/Trenching

Related SPOPSFLDs: FLD02 - Inclement Weather
FLD08 - Confined Spaces Entry
FLD26A - Portable Ladders
FLD34A - Underground Utilities

No person may enter a trench or work at the foot of the face of an excavation until **the Site Health and Safety Coordinator has inspected** and determined whether sloping or shoring is required to protect against cave-in or subsidence and the appropriate protection has been installed.

Trench and excavations must be inspected regularly by competent persons to ensure that changes in temperature, precipitation, shallow groundwater, over burden or nearby building weight, vibration or nearby equipment operation have not caused weakening of sides, faces and floors, and that protection is being maintained.

This assessment must be made, regardless of whether or not personnel will be working within, when heavy equipment must work nearby, prior to and during use, to ensure the trench or excavation will support the weight of the equipment without subsiding and possibly causing the equipment to tip.

Sufficient ramps or ladders must be provided to trenches or excavations to allow quick egress. Ladders may be placed no more than 25' apart, must be secured from shifting, and must extend at least three feet above the landing point. Use, construction, and maintenance of ladders must conform to ladder safety requirements.

A competent person must design and supervise construction of shoring, sheeting, and/or sloping.

Material removed from a trench or excavation must be placed far enough from the edge (at least 2' feet) to prevent its sliding into the excavation and/or from stressing the trench or excavation walls.

Access to trenching areas must be controlled and limited to those persons who are authorized. Prior to entering a trench or excavation, workers must notify the site supervisor, site health and safety coordinator, and nearby equipment operators whose activities could affect the trench or excavation.

If trenches or excavations are near walkways or roadways, guards or warning barriers must be placed to alert pedestrians and drivers of the presence of the trench or excavation.

2.4.34 Excavating/Trenching - FLD28 (continued)

If possible, trenches or excavations should be covered or filled in when unattended; otherwise, strong barriers must be placed around the trench or excavation, and lighting must be provided at night if the trench or excavation is near walkways or roadways.

2.4.36 Hazardous Materials Use and Storage - FLD30

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD30 - Hazardous Materials Use and Storage

Related SPOPSFLDs:
- FLD21 - Explosives
- FLD31 - Fire Prevention/Protection/Response Plans
- FLD32 - Fire Extinguishers Required and Requirements

2.4.36.1 Flammable Liquids

Flammable liquids shall 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.

Fuels shall be separated from oxidizers and corrosives must be separated from flammables and stored in approved cabinets or store rooms or separated by 25 feet from other storage areas or buildings.

Approved grounding and bonding procedures shall 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 (Division) according to the National Electric Code (National Fire Protection Association). Electrical equipment use must conform to these codes.

All tanks, containers, and pumping equipment, portable or stationary, used for the storage or handling of flammable and combustible liquids will be listed by UL or FM or approved by the MSHA.

As a minimum, a 10 lb fire extinguisher appropriate for the type of fire that could occur must be within 50 feet of any accumulation of five gallons or more of flammable liquids or gases.

2.4.36.2 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.
- Cylinder caps must be in place, when cylinders are not in use.
- Cylinders should be stored out of direct sunlight.

2.4.36.2 Cylinders (continued)

- Cylinders containing fuels, e.g., acetylene, must be separated from oxidizers, e.g., oxygen, carbide, by 20 feet or a five (5) foot high fire wall with a minimum 1/2 hour fire resistance if outside or 1 hour rating if inside.

2.4.40 Utilities - General - FLD34

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD34 - Utilities - General

Related SPOPSFLDs:
- FLD03 - Hot Processes - Steam
- FLD22A - Heavy Equipment Operation - General
- FLD22B - Heavy Equipment Operation - Drill Rigs
- FLD23 - Cranes/Lifting Equipment
- FLD28 - Excavating and Trenching
- FLD35A - Electrical Safety - General
- FLD35B - Electrical Safety - High Voltage

2.4.40.1 Survey for and Identification of Utilities

Prior to beginning work on site or in or around facilities, buildings, or other structures that could be served by or connected to utilities, a search must be conducted by the SHSC, ideally in association with someone familiar with the facility, to identify any overhead, underground, and in-workplace utilities such as:

- Electrical lines and appliances
- Gas lines
- Pipelines
- Steam lines
- Water lines
- Sewer lines
- Pressured air lines

The location of any utility that could pose a risk to workers must be communicated to all workers during site safety indoctrination. Utilites should be marked or access otherwise restricted to avoid chance of accidental contact.

Utilities shall be considered "live" or active until a reliable source has documented them to be otherwise.

2.4.40.2 Overhead Utilities

For operations adjacent to overhead power lines:

- Overhead transmission and distribution lines will be carried on towers and poles which 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 shall be considered "live" or active until a reliable source has documented them to be otherwise.

2.4.40.2 Overhead Utilities (Continued)

Elevated work platforms, ladders, scaffolding, man-lifts, drill or vehicle superstructures shall be erected a minimum of 20 feet (The actual distance is dependant 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 can not occur between the workplace or superstructure.

For other overhead or in-workplace utilities, workers must be instructed to use care in working under or around utilities to avoid hot surfaces, loud noises, pressured gases or air, leaking of pipelines, discharge of steam or hot liquids, and must work to prevent accidental contact with or breakage.

2.4.40.3 Underground Utility Searches

No excavating, drilling, or boring shall be done until a thorough underground utility survey, conducted by knowledgeable persons or agencies, has been made and it is found safe to begin.

Even when a search is completed, drilling, boring and excavation should commence carefully until past the depth at which such utilities are usually located.

All underground utilities shall be considered "live" or active until reliable sources demonstrate otherwise.

The SHSC is responsible for ensuring underground utility searches are performed and procedures are conformed with.

2.4.43 Welding/Cutting/Burning - FLD36

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD36 - Welding/Cutting/Burning

Related SPOPs:
- FLD01 - Noise Protection
- FLD02 - Inclement Weather
- FLD08 - Confined Spaces Entry
- FLD09 - Hot Work
- FLD10 - Manual Lifting and Handling of Heavy Objects
- FLD11 - Housekeeping
- FLD16 - Compressed Gases
- FLD22A - Heavy Equipment Operation - General
- FLD24 - Aerial Lifts/Manlifts
- FLD29 - Materials Handling
- FLD30 - Hazardous Materials Use and Storage
- FLD31 - Fire Prevention/Protection/Response Plan
- FLD32 - Fire Extinguishers Required and Requirements
- FLD34 - Utilities
- FLD35A - Electrical Safety - General
- FLD35B - Electrical Safety - High Voltage
- FLD38 - Hand and Power Hand Tools

Welding, cutting, and burning shall be performed only by those persons competent by reason of formal training or documented experience.

2.4.45 Hand and Power Hand Tools - FLD38

Health and Safety Plan Operating Procedures

Field Operating Procedure - FLD38 - Hand and Power Hand Tools

Related SPOPS:			
	FLD01	-	Noise Protection
	FLD02	-	Inclement Weather
	FLD08	-	Confined Spaces Entry
	FLD09	-	Hot Work
	FLD10	-	Manual Lifting and Handling of Heavy Objects
	FLD11	-	Housekeeping
	FLD16	-	Compressed Gases
	FLD22A	-	Heavy Equipment Operation - General
	FLD24	-	Aerial Lifts/Manlifts
	FLD29	-	Materials Handling
	FLD30	-	Hazardous Materials Use and Storage
	FLD31	-	Fire Prevention/Protection/ Response Plans
	FLD32	-	Fire Extinguishers Required and Requirements
	FLD34	-	Utilities
	FLD35A	-	Electrical Safety - General
	FLD35B	-	Electrical Safety - High Voltage

Work with other than the simplest non-powered hand tool shall be performed only by those persons competent by reason of formal training or documented experience.

In addition to the above-related Physical Hazard Safety Procedures, the following procedures must be followed.

Unsafe hand tools shall not be issued or used. All hand tools will be kept in good repair and used only for the purposes for which they were designed. Wrenches with sprung jaws, where slippage could occur, impact tools with mushroomed heads, and wooden handled tools with cracks or splinters are examples of unsafe hand tools.

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

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

Proper PPE must be used when operating power tools or hand tools that may produce projectiles, cuts or abrasions, dusts, fume, 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.

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 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 1926.404.

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.

Manufacturer's safe operating pressures for hydraulic hoses, valves, pipes, filters, and other fitting will not be exceeded.

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

Loose and frayed clothing, loose long hair, dangling jewelry, rings, chains, and wrist watches will not be worn while working with any power tool or machine.

All woodworking tools and machinery will meet applicable requirements of ANSI 01.1, Safety Code for Woodworking Machinery.

Extension cords:

- Must meet UL or other rating criteria according to OSHA.
- Use will be limited to essential tasks.
- Must be tested for continuity before each use and must be connected to grounded outlets or ground fault current interrupters must be used.
- Must be inspected daily for loose insulation, broken or missing plugs, bared wires, etc.
- Grounding of outlets used for portable tools must be confirmed before use.

- Must not be allowed to become tripping or slipping hazards.
- Must not be used for lifting, tying off, and shall be disconnected by pulling on the plug.

Any piece of equipment used for lifting materials or personnel shall be used and maintained in strict accordance with manufacturer's directions and applicable OSHA regulations.

Load limits will be visibly posted on all lifting devices.

Only operators with demonstrated competence shall be permitted to operate lifting devices.

Lifting machinery and all elements of equipment involved in lifting or supporting loads must be inspected prior to use and at a minimum monthly. Inspections must be performed by a competent person and must be documented.

APPENDIX C

DRILLING SAFETY GUIDE

2.5 DRILLING SAFETY GUIDE

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.

- 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.

- Replace all caps, filler plugs, protective guards or panels, and high pressure hose clamps, chains or cables that have been removed for maintenance before returning the drill rig to service.

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 releveled 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.

- 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 <u>React to Contact with Electricity</u>

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:

- 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 then 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.

- 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 hallow-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.

- 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 manufacture'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 <u>Safety During Rotary And Core Drilling</u>

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.

- 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.

2.5.19 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.

2.5.24 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.

2.6 DRILL RIG SAFETY INSPECTION LIST

DRILL RIG INSPECTION CHECKLIST

Answer Yes or No, and make any additional comments you feel are necessary. Potions 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: _____

_____

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: _____

_____

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: _____

_____

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: _____

_____

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: _____

_____

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. <u>HAND TOOL SAFETY</u>

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: _____

_____

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? _____ If 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 bannerguard 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: _____

_____

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.

2.7 EQUIPMENT/TRUCK INSPECTION CHECKLIST

EQUIPMENT/TRUCKING INSPECTION CHECKLIST

This inspection form is to be filled out at the start of the work shift by the Equipment/Truck Operator to insure that the equipment/truck is safe to operate and is free from apparent damage which could cause failure while in use. Once completed this form is to be given to the Site Manager to be kept on file on-site. In all cases, consult the manufacturer's data to ensure compliance with all inspection criteria which may not be indicated below.

MAKE/DESCRIPTION _____
MODEL/SERIAL _____

	OK	NOT OK	COMMENT AND ACTIONS TAKEN
BRAKES:	___	___	_____
BRAKE LIGHTS:	___	___	_____
REVERSE SIGNAL ALARM:	___	___	_____
HORN:	___	___	_____
TIRES:	___	___	_____
STEERING:	___	___	_____
SEAT BELTS:	___	___	_____
OPERATING CONTROLS:	___	___	_____
FIRE EXTINGUISHER:	___	___	_____
LIGHTS:	___	___	_____
DEFROSTER:	___	___	_____
MIRRORS:	___	___	_____
INSTRUMENTS:	___	___	_____
COUPLING DEVICES:	___	___	_____
WINDSHIELD/WINDOW GLASS:	___	___	_____
WINDSHIELD WIPER:	___	___	_____
MUD FLAPS/ROCK GUARDS:	___	___	_____
EXHAUST SYSTEM:	___	___	_____
HITCHES & SAFETY CABLES:	___	___	_____
HYDRAULIC LINES/ AIR HOSES:	___	___	_____
ENGINE OIL LEVEL:	___	___	_____
ROLL-OVER PROTECTION/ EMERGENCY EQUIPMENT:	___	___	_____

ODOMETER: _____ HOUR METER: _____
FUEL LEVEL: _____

INSPECTOR NAME/SIGNATURE: _____

DATE: _____ TIME: _____

APPENDIX D

MATERIAL SAFETY DATA SHEETS

MATERIAL SAFETY DATA SHEET

ABBOTT LABORATORIES
DIAGNOSTICS DIVISION
ABBOTT PARK, ILLINOIS 60064
Emergency Telephone 1-708-937-7970

ISSUE DATE: 11/22/89 TSCA STATUS: 7647-01-0 APPROVAL: _____

List/Code: /5697

Product Name: Hydrochloric Acid, 1 Normal

Chemical Name: Hydrochloric Acid

Dot Classification: Corrosive Material

HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Name (CAS No.)	OSHA PEL	ACGIH TLV	ABBOTT LIMIT	%
Hydrochloric Acid (7647-01-0)	5ppm (C)	5 ppm (C)	N/A	4

PHYSICAL PROPERTIES

Appearance: Clear, colorless liquid

Solubility: Complete

Boiling Point: ND
Melting Point: ND
pH: 0.1
Vapor Pressure: 14 (H_2O)
Vapor Density: 0.7 (H_2O)
Specific Gravity: 1.018
Viscosity: ND

FIRE AND EXPLOSION DATA

Flash Point: N/A

Extinguishing Media: Any media suitable for surrounding fire

Special Fire Fighting Procedures: N/A

Unusual Fire and Explosion Hazards: None. However, avoid splashing if water is used.

REACTIVITY

Incompatibility: Reagent is a dilution of a strong inorganic acid and will react with metals.

Hazardous Decomposition or By-Product: Hydrogen gas

Conditions to Avoid: Material is stable under normal conditions

Product Name: Hydrochloric acid, 1 Normal

HEALTH HAZARD DATA

Route(s) of entry: Inhalation - yes Skin - ND Ingestion - ND

Oral Toxicity: ND. LD50 = 900 mg/kg in rabbits for hydrochloric acid. Estimated fatal dose 1 gram or 1 milliliter although survival from 4-8 oz. of hydrochloric acid has been reported.

Dermal Toxicity: ND

Inhalation Toxicity: ND. LC50 = 1108-3124 ppm/1hr in mice and rats for hydrochloric acid; LCLO in man reported to be 3000 ppm/5 min. and 1300 ppm/30 min.

Corrosiveness: Corrosive. Strong acids can produce irreversible tissue damage.

Dermal Irritation: Irritant. Strong acids can severely irritate the skin.

Ocular Irritation: Irritant. 0.25-1 N hydrochloric acid caused scaring of rabbit cornea. 5% (about 1 N) reported to produce only moderate irritation, without permanent injury, in man.

Dermal Sensitization: Low potential as a dermal sensitizer.

Special Target Organ Effects: ND. Long-term exposure to hydrochloric acid can cause erosion of teeth, irritation of the respiratory tract and gastrointestinal disturbances.

Carcinogenicity: NTP - NL IARC - NL OSHA - NL ACGIH - NL

Signs and Symptoms of Exposure: ND. May cause burning sensation and irritation to any exposed body surface, to the respiratory tract, or to the gastrointestinal tract.

Medical Conditions Aggravated by Exposure: ND. Data suggest pre-existing skin, eye, respiratory or gastrointestinal lesions.

Emergency and First Aid Procedures: Remove from source of exposure. If skin or eye contact occurs, flush with copious amounts of water. If irritation persists or signs of toxicity occur, seek medical attention. No known antidote. Provide symptomatic/supportive care as necessary.

SPECIAL PROTECTION INFORMATION

Ventilation: General room ventilation is adequate.

Respirator: None required under normal use.

Gloves: Acid resistant (rubber).

Eye Protection: Chemical goggles/safety glasses.

Other Protection: No other special protective measures are anticipated under normal use.

Special Precautions; Always store below waist level and away from direct sunlight.

Product Name: Hydrochloric acid, 1 Normal

SPECIAL PROTECTION INFORMATION

Spill or Release Procedures: Cover with soda ash, scoop up and place in a suitable container, dilute area with water.

Waste Disposal: Dispose of by means as to comply with all local, state and federal regulations.

Other Handling: None

Legend

N/A - Not Applicable
N/D - Not Determined
NL - Not Listed

The information and recommendations contained herein are based upon tests believed to be reliable. However, Abbott Laboratories does not guarantee their accuracy or completeness NOR SHALL ANY OF THIS INFORMATION CONSTITUTE A WARRANTY, WHETHER EXPRESSED OR IMPLIED, AS TO THE SAFETY OF THE GOODS, THE MERCHANTABILITY OF THE GOODS, OR THE FITNESS OF THE GOODS FOR A PARTICULAR PURPOSE. Adjustment to conform with actual conditions of usage may be required. Abbott Laboratories assumes no responsibility for results obtained or for incidental or consequential damages arising from the use of this data. No freedom from infringement of any patent, copyright or trademark is to be inferred.

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Telex: 26 843 Aldrich MI
FAX: (414) 273-4979

ATTN: SAFETY DIRECTOR
ABBOTT LABS
DIAGNOSTICS DIVISION
ABBOTT PARK IL 60064
FRANK F. MILLER

DATE: 10/20/88
CUST # 100064 P.O. #

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT
CAS # 7647-01-0
MF: HCL

SYNONYMS
ACIDE CHLORHYDRIQUE (FRENCH) * ACIDO CLORIDRICO (ITALIAN) * CHLOORWATERSTOF (DUTCH) * CHLOROHYDRIC ACID * CHLOROWODOR (POLISH) * CHLORWASSERSTOFF (GERMAN) * HYDROCHLORIC ACID, ANHYDROUS (DOT) * HYDROCHLORIC ACID (DOT) * HYDROCHLORIC ACID, SOLUTION (DOT) * HYDROCHLORIC ACID, SOLUTION, INHIBITED (DOT) * HYDROCHLORIDE * HYDROGEN CHLORIDE (ACGIH,DOT) * HYDROGEN CHLORIDE, ANHYDROUS (DOT) * HYDROGEN CHLORIDE, REFRIGERATED LIQUID (DOT) * MURIATIC ACID * MURIATIC ACID (DOT) * SPIRITS OF SALT * SPIRITS OF SALT (DOT) * UN 1050 (DOT) * UN 1789 (DOT) * UN 2186 (DOT) *

TOXICITY HAZARDS

RTECS # MW4025000
HYDROCHLORIC ACID

IRRITATION DATA
EYE-RBT 5 MG/30S RINSE MLD TXCYAC 23,281,82

TOXICITY DATA
IHL-HMN LCLO:1300 PPM/30M 29ZWAE -,207,68
IHL-HMN LCLO:3000 PPM/5M TABIA2 3,231,33
UNR-MAN LDLO:81 MG/KG 85DCAI 2,73,70
IHL-RAT LC50:3124 PPM/1H AMRL** TR-74-78,74
IHL-MUS LC50:1108 PPM/1H JCTODH 3,61,76
IPR-MUS LD50:1449 MG/KG CDREAF 256,1043,63
ORL-RBT LD50:900 MG/KG BIZEA2 134,437,23

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 5 PPM 85INA8 5,313,86
OSHA STANDARD-AIR:CL 5 PPM FEREAC 39,23540,74
EPA GENETOX PROGRAM 1986, NEGATIVE: CELL TRANSFORM.-SA7/SHE
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0578-0146
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, MARCH 1988
NIOSH ANALYTICAL METHODS: SEE ACIDS, INORGANIC, 7903
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

TARGET ORGAN DATA
SENSE ORGANS AND SPECIAL SENSES (OTHER EYE EFFECTS)
LUNGS, THORAX OR RESPIRATION (RESPIRATORY STIMULATION)
SKIN AND APPENDAGES (AFTER SYSTEMIC EXPOSURE: DERMATITIS, OTHER)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.

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9A

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CATALOG # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT

INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA. SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.

FIRST AID

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF EXPOSURE, OBTAIN MEDICAL ATTENTION IMMEDIATELY.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

SPECIFIC GRAVITY: 1.200
VAPOR DENSITY: 1.3
VAPOR PRESSURE: 3.23 PSI @ 21.1 C
7.93 PSI @ 37.7 C

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE

EXTINGUISHING MEDIA

NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NOT APPLICABLE

REACTIVITY DATA

INCOMPATIBILITIES

BASES
AMINES
ALKALI METALS
COPPER, COPPER ALLOYS
ALUMINUM
CORRODES STEEL
DO NOT ALLOW WATER TO ENTER CONTAINER BECAUSE OF VIOLENT REACTION.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

TOXIC FUMES OF:
HYDROGEN CHLORIDE GAS

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

ALDRICH ®

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CATALOG # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT

WASTE DISPOSAL METHOD

FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

CHEMICAL SAFETY GOGGLES.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
NIOSH/MSHA-APPROVED RESPIRATOR IN NONVENTILLATED AREAS AND/OR FOR EXPOSURE ABOVE THE ACGIH TLV.
MECHANICAL EXHAUST REQUIRED.
RUBBER GLOVES.
DO NOT PIPET BY MOUTH.
AVOID BREATHING VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
POISON.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

NOT APPLICABLE

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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Mallinckrodt
Material Safety Data

Emergency Phone Number: 314-982-5000

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Mallinckrodt, Inc., Science Products Division, P.O. Box M, Paris, KY 43061.

HYDROCHLORIC ACID, 37%

PRODUCT IDENTIFICATION:

Synonyms: Muriatic acid

Formula CAS No.: 7647-01-0

Molecular Weight: 36.46 (HCl)

Chemical Formula: HCl

Hazardous Ingredients: Not Applicable

PRECAUTIONARY MEASURES

DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE.

Do not get in eyes, on skin, or on clothing.
Avoid breathing mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: Clear, colorless fuming liquid.

Odor: Pungent odor of hydrogen chloride.

Solubility: Infinite in water with slight evolution of heat.

Boiling Point: 53°C (127°F); Azeotrope (20.2%) boils at 109°C (228°F)

Melting Point: -74°C (-101°F)

Specific Gravity: 1.18

Vapor Density (Air = 1): No information found.

Vapor Pressure (mm Hg): 190 @ 25°C (77°F)

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Can react with metals to release flammable hydrogen gas.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
If involved in a fire, use water spray.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.

SECTION 4 Leak/Spill Disposal Information

Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic or corrosive fluids or vapors. Isolate or enclose the area of the leak or spill. Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). Sewer neutralized material with excess water. Larger spills and lot sizes: Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite). Provide forced ventilation to dissipate fumes. Dispose in a RCRA-approved waste facility or sewer the neutralized slurry with excess water if local ordinances allow.

Reportable Quantity (RQ)(CWA/CERCLA) : 5000 lbs.

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflamation of the nose, throat, and upper respiratory tract. Inhalation of higher concentrations may cause lung damage.

Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea.

Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.

Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Splashes may cause severe burns and permanent eye damage.

Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

B. FIRST AID

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1982)

Oral rat LD50: 900 mg/kg (Hydrochloric acid concentrated) Mutation references cited.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
5 ppm (TWA) Ceiling
-ACGIH Threshold Limit Value (TLV):
5 ppm (TWA) Ceiling

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible.Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Protect from moisture.

H3680 -02 HYDROCHLORIC ACID PAGE:
EFFECTIVE: 08/07/86 ISSUED: 08/15/

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: HYDROCHLORIC ACID
FORMULA: HCl
FORMULA WT: 36.46
CAS NO.: 7647-01-0
NIOSH/RTECS NO.: MW4025000
COMMON SYNONYMS: MURIATIC ACID; CHLOROHYDRIC ACID; HYDROCHLORIDE
PRODUCT CODES: 9543,9539,9535,5367,9534,9544,9529,9542,4800,9549,9530,9548
9540, 9547, 9546, 9537

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	(POISON) SEVERE
FLAMMABILITY	-	0	
REACTIVITY	-	2	(MODERATE)
CONTACT	-	3	(SEVERE)

LABORATORY PROTECTIVE EQUIPMENT

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

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
CAUSES SEVERE BURNS
MAY BE FATAL IF SWALLOWED OR INHALED
DO NOT GET IN EYES, ON SKIN OR CLOTHING.
DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. LOOSEN CLOSURE CAUTIOUSLY. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.
IN CASE OF SPILL NEUTRALIZE WITH SODA ASH OR LIME AND PLACE IN DRY CONTAINER.

SECTION II - HAZARDOUS COMPONENTS

COMPONENT	%	CAS N
HYDROCHLORIC ACID (23 BAUME)	35-40	7647-01

SECTION III - PHYSICAL DATA

BOILING POINT: 110 C (230 F)
VAPOR PRESSURE(MM HG):N/A

MELTING POINT: -25 C (-13 F)
VAPOR DENSITY(AIR=1): 1.3

SPECIFIC GRAVITY: 1.19 (H2O=1)
EVAPORATION RATE: N/A (BUTYL ACETATE=1)

CONTINUED ON PAGE: 2

SECTION III - PHYSICAL DATA (CONTINUED)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR, COLORLESS OR SLIGHTLY YELLOW, PUNGENT, FUMING LIQUI

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: N/A NFPA 704M RATING: 3-0-0
FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %
FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MOD MOVE 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
MAY EMIT HYDROGEN GAS UPON CONTACT WITH METAL.
TOXIC GASES PRODUCED
HYDROGEN CHLORIDE, HYDROGEN GAS

SECTION V - HEALTH HAZARD DATA

PEL AND TLV LISTED DENOTE CEILING LIMIT.
THRESHOLD LIMIT VALUE (TLV/TWA): 7 MG/M3 (5 PPM)
PERMISSIBLE EXPOSURE LIMIT (PEL): 7 MG/M3 (5 PPM)
TOXICITY: LD50 (ORAL-RABBIT)(MG/KG):900 LD50 (IPR-MOUSE)(MG/KG): 40
LC50 (INHL-RAT-1H)(PPM): 3124
CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO
EFFECTS OF OVEREXPOSURE: INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA, CIRCULATORY SYSTEM COLLAPSE, DAMAGE TO UPPER RESPIRATORY SYSTEM, COLLAPSE. INHALATION OF VAPORS MAY CAUSE COUGHING AND DIFFICULTY BREATHING. LIQUID MAY CAUSE SEVERE BURNS TO SKIN AND EYES. INGESTION IS HARMFUL AND MAY BE FATAL. INGESTION MAY CAUSE SEVERE BURNING TO MOUTH AND STOMACH. INGESTION MAY CAUSE NAUSEA AND VOMITING.

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

EMERGENCY & 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.

CONTINUED ON PAGE: 3

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, MOISTURE
INCOMPATIBLES: MOST COMMON METALS, WATER, AMINES, METAL OXIDES, ACETI ANHYDRIDE, PROPIOLACTONE, VINYL ACETATE, MERCURIC SULFATE, CALCIUM PHOSPHIDE, FORMALDEHYDE, ALKALIES, CARBONATES, STRONG BASES, SULFURIC ACID, CHLOROSULFONIC ACID
DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, HYDROGEN, CHLORINE

SECTION VII - 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 DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

J. T. BAKER NEUTRASORB(R) OR NEUTRASOL(R) "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: D002 (CORROSIVE WASTE)

SECTION VIII - 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, ACID-RESISTANT GLOVES ARE RECOMMENDED.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN CORROSION-PROOF AREA. ISOLATE FROM INCOMPATIBLE MATERIALS. DO NOT STORE NEAR OXIDIZING MATERIALS.

CONTINUED ON PAGE: 4

SECTION IX - STORAGE AND HANDLING PRECAUTIONS (CONTINUED)

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	HYDROCHLORIC ACID
HAZARD CLASS	CORROSIVE MATERIAL (LIQUID)
UN/NA	UN1789
LABELS	CORROSIVE
REPORTABLE QUANTITY	5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	HYDROCHLORIC ACID, SOLUTION
HAZARD CLASS	8
UN/NA	UN1789
LABELS	CORROSIVE

N/A = NOT APPLICABLE OR NOT AVAILABLE

THE INFORMATION PUBLISHED IN THIS MATERIAL SAFETY DATA SHEET HAS BEEN COMPILED FROM OUR EXPERIENCE AND DATA PRESENTED IN VARIOUS TECHNICAL PUBLICATIONS. IT I THE USER'S RESPONSIBILITY TO DETERMINE THE SUITABILITY OF THIS INFORMATION FOR THE ADOPTION OF NECESSARY SAFETY PRECAUTIONS. WE RESERVE THE RIGHT TO REVISE MATERIAL SAFETY DATA SHEETS PERIODICALLY AS NEW INFORMATION BECOMES AVAILABLE.

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J.T.BAKER INC., [illegible] PHILLIPSBURG, NJ [illegible]

SECTION 1 PRODUCT IDENTIFICATION

PRODUCT NAME: HYDROCHLORIC ACID
COMMON SYNONYMS: MURIATIC ACID; CHLORHYDRIC ACID; HYDROGEN CHLORIDE, ANHYDRO
CHEMICAL FAMILY: INORGANIC ACIDS
FORMULA: HCL
FORMULA WT.: [illegible]
CAS NO.: [illegible]
NIOSH/RTECS NO.: [illegible]
PRODUCT USE: LABORATORY [illegible]
PRODUCT CODES: [illegible]

PRELIMINARY LABELING

BAKER SAFETY-DATA SYSTEM

HEALTH	SEVERE (POISON)
FLAMMABILITY	[illegible]
REACTIVITY	[illegible]
CONTACT	SERIOUS (CORROSIVE)

LABORATORY PROTECTIVE EQUIPMENT

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

USE PRECAUTIONARY LABELING

POISON DANGER

CAUSES SEVERE BURNS. MAY BE FATAL IF SWALLOWED, INHALED. DO NOT GET IN EYES, ON SKIN, ON CLOTHING. DO NOT BREATHE VAPOR. CAUSES DAMAGE TO RESPIRATORY SYSTEM (LUNGS), EYES AND SKIN. KEEP IN TIGHTLY CLOSED CONTAINER. LOOSEN CLOSURE CAUTIOUSLY. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IF SPILLED, NEUTRALIZE WITH SODA ASH OR LIME AND PLACE IN DRY CONTAINER.

CONTINUED ON PAGE: 2

PRECAUTIONARY LABELING (CONTINUED)

INTERNATIONAL LABELING

IRRITATING TO EYES AND SKIN.
KEEP OUT OF REACH OF CHILDREN. IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.

SAFET-DATA# STORAGE COLOR CODE: WHITE (CORROSIVE)

SECTION II - COMPONENTS

COMPONENT	CAS No.	WEIGHT %	TWA/PEL	ACGIH/TLV
HYDROCHLORIC ACID	7647-01-0	36.5	5 PPM	5 PPM
WATER	7732-18-5	63.5	N/A	N/A

SECTION III - PHYSICAL DATA

BOILING POINT: 110 C (230 F)
(AT 760 MM HG)

VAPOR PRESSURE (MMHG): N/A

MELTING POINT: -38 C (-36 F)
(AT 760 MM HG)

VAPOR DENSITY (AIR=1): 1.3

SPECIFIC GRAVITY: 1.19
(H2O=1)

EVAPORATION RATE: N/A

SOLUBILITY(H2O): COMPLETE (100%)

% VOLATILES BY VOLUME: 100
(21 C)

PH: 1.0 (0.1M SOLUTION)

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: LIQUID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: CLEAR, COLORLESS FUMING LIQUID. PUNGENT ODOR.

CONTINUED ON PAGE: 3

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): N/A NFPA FIRE RATING: 0-0-0

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER N/A LOWER N/A

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIREFIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PERSONAL 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. DO NOT GET WATER INSIDE CONTAINERS.

UNUSUAL FIRE & EXPLOSION HAZARDS
MAY EMIT HYDROGEN GAS UPON CONTACT WITH METAL.

TOXIC GASES PRODUCED
HYDROGEN CHLORIDE, HYDROGEN.

EXPLOSION DATA SENSITIVITY TO MECHANICAL IMPACT
NONE IDENTIFIED.

EXPLOSION DATA SENSITIVITY TO STATIC DISCHARGE
NONE IDENTIFIED.

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 7 MG/M3 (5 PPM)

TLV (CEILING) IS FOR HYDROGEN CHLORIDE.

SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

PERMISSIBLE EXPOSURE LIMIT (PEL): 7 MG/M3 (5 PPM)

PEL (CEILING) IS FOR HYDROGEN CHLORIDE.

CONTINUED ON PAGE: 4

SECTION V - HEALTH HAZARD DATA (CONTINUED)

TOXICITY OF COMPONENTS

INTRAPERITONEAL MOUSE LD50 FOR HYDROCHLORIC ACID	40	MG/KG
ORAL RABBIT LD50 FOR HYDROCHLORIC ACID	900	MG/KG
INHALATION 1HR RAT LC50 FOR HYDROCHLORIC ACID	3124	PPM
INTRAPERITONEAL MOUSE LD50 FOR WATER	190	G/KG
INTRAVENOUS MOUSE LD50 FOR WATER	25	G/KG

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

CARCINOGENICITY
NONE IDENTIFIED.

REPRODUCTIVE EFFECTS
NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: PULMONARY EDEMA, CIRCULATORY FAILURE, RESPIRATORY SYSTEM DAMAGE, COLLAPSE, COUGHING, DIFFICULT BREATHING

SKIN CONTACT: SEVERE BURNS

EYE CONTACT: SEVERE BURNS

SKIN ABSORPTION: NOT IDENTIFIED

INGESTION: IS HARMFUL AND MAY BE FATAL, SEVERE BURNS TO MOUTH, THROAT, AND STOMACH, NAUSEA, VOMITING

CHRONIC EFFECTS: NOT IDENTIFIED

TARGET ORGANS
RESPIRATORY SYSTEM, EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

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

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SECTION V - HEALTH HAZARD DATA (CONTINUED)

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, DO NOT INDUCE VOMITING. IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.

INHALATION: IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE REUSE.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE: YES (CONTAINS HYDROGEN CHLORIDE (RQ) = 5000 LBS, TPQ = 500 LBS)
CERCLA HAZARDOUS SUBSTANCE: YES (CONTAINS HYDROCHLORIC ACID (RQ) = 5000 LBS)
TOXIC CHEMICALS: YES (CONTAINS HYDROCHLORIC ACID)
GENERIC CLASS: N/A
TSCA INVENTORY: YES

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, MOISTURE

INCOMPATIBLES: MOST COMMON METALS, WATER, AMINES, METAL OXIDES, ACETIC ANHYDRIDE, BETA-PROPIOLACTONE, VINYL ACETATE, MERCURIC SULFATE, CALCIUM PHOSPHIDE, FORMALDEHYDE, ALKALIES, CARBONATES, STRONG BASES, SULFURIC ACID, CHLOROSULFONIC ACID

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, HYDROGEN, CHLORINE

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SECTION VII - SPILL & 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, DRY CONTAINER AND COVER. REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

J. T. BAKER NEUTRASORB(R) OR [illegible] ACID NEUTRALIZING 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: NONE (CORROSIVE WASTE)

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

VENTILATION: USE [illegible] LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: [illegible] MAY BE REQUIRED IF EXPOSURE [illegible] ACID EXCEEDS TLV. AT CONCENTRATIONS UP TO 10 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, RUBBER GLOVES AND ROOM SHOES.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

NAPHT-DATAR STORAGE COLOR CODE: WHITE (CORROSIVE)

STORAGE REQUIREMENTS
KEEP CONTAINER TIGHTLY CLOSED. [illegible] ISOLATE FROM INCOMPATIBLE MATERIALS. DO NOT STORE NEAR OXIDIZING MATERIALS.

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SECTION X TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: HYDROCHLORIC ACID
HAZARD CLASS: CORROSIVE MATERIAL (LIQUID)
UN/NA: UN1789 REPORTABLE QUANTITY: [illegible] LBS.
LABELS: CORROSIVE
REGULATORY REFERENCES: 49CFR 172.101; 172.202

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: HYDROCHLORIC ACID SOLUTION
HAZARD CLASS: I.M.O. PAGE: 8174
UN: UN1789 MARIN. POLLUTANT: [illegible] PACKAGING GROUP: II
LABELS: CORROSIVE
REGULATORY REFERENCES: 49CFR 172.101; PART 176; IMO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: HYDROCHLORIC ACID SOLUTION
HAZARD CLASS: [illegible]
UN: UN1789 PACKAGING GROUP: II
LABELS: CORROSIVE
REGULATORY REFERENCES: 49CFR 172.101; 172.[illegible]; PART 175; ICAO/IATA

U.S. CUSTOMS HARMONIZATION [illegible] 31 [illegible]

N/A = NOT APPLICABLE OR NOT AVAILABLE
N/E = NOT ESTABLISHED

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR APPLICATION. [illegible] GLOVES, [illegible] GLASSES INCLUDING EYE AND FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.
EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. FOR THE POTENTIAL USES

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ARE SO VARIED, BAKER CANNOT MAKE OR ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL. BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.
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LAST PAGE

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INDEX: 01901010827 CAT NO: A144C212 PO NBR: 135309

HYDROCHLORIC ACID, CONCENTRATED (36-37%)
HYDROCHLORIC ACID, CONCENTRATED (36-37%)
HYDROCHLORIC ACID, CONCENTRATED (36-37%)

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7647-01-0
SUBSTANCE: **HYDROCHLORIC ACID, CONCENTRATED (36-37%)**

TRADE NAMES/SYNONYMS:
CHLOROHYDRIC ACID; HYDROCHLORIDE; MURIATIC ACID; SPIRITS OF SALT; HYDROCHLORIC ACID, CONCENTRATED; HYDROGEN CHLORIDE, 23 EB; UN 1789; A-142; A-144; A-508; A-486; ACC11155

CHEMICAL FAMILY:
INORGANIC ACID

MOLECULAR FORMULA: H-CL

MOLECULAR WEIGHT: 36.46

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: HYDROGEN CHLORIDE PERCENT: 37

COMPONENT: WATER PERCENT: 63

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
5 PPM OSHA CEILING
5 PPM ACGIH CEILING

500 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY (GAS)
1 POUND SARA SECTION 304 REPORTABLE QUANTITY (GAS)
5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY (LIQUID)
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: COLORLESS OR SLIGHTLY YELLOW FUMING LIQUID WITH A PUNGENT ODOR. BOILING POINT: 384 F (196 C) SPECIFIC GRAVITY: 1.2

VAPOR PRESSURE: NOT AVAILABLE PH: 1.1 (0.1 N)

SOLUBILITY IN WATER: SOLUBLE VAPOR DENSITY: 1.3

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 60).

EXTINGUISH USING AGENTS SUITABLE FOR TYPE OF FIRE. USE FLOODING AMOUNTS OF WATER AS FOG. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS. KEEP UPWIND.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
CORROSIVE MATERIAL

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND SUBPART E:
CORROSIVE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.263
EXCEPTIONS: 49CFR173.244

TOXICITY

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
IRRITATION DATA:
ANHYDROUS: 100 MG RINSED EYE-RABBIT MILD.
TOXICITY DATA:
HYDROGEN CHLORIDE (ANHYDROUS GAS): 4701 PPM/30 MINUTES INHALATION-RAT LC50; 2644 PPM/30 MINUTES INHALATION-MOUSE LC50.
MONOHYDRATE: NO DATA AVAILABLE.
DIHYDRATE: NO DATA AVAILABLE.
TRIHYDRATE: NO DATA AVAILABLE.
HEXAHYDRATE: NO DATA AVAILABLE.
HYDROGEN CHLORIDE (AEROSOL): 5666 PPM/30 MINUTES INHALATION-RAT LC50; 2142 PPM/30 MINUTES INHALATION-MOUSE LC50.
HYDROCHLORIC ACID: 1300 PPM/30 MINUTES INHALATION-HUMAN LCLO; 3000 PPM/5 MINUTES INHALATION-HUMAN LCLO; 81 MG/KG UNREPORTED MAN LDLO; 3124 PPM/1 HOUR INHALATION-RAT LC50; 1108 PPM/1 HOUR INHALATION-MOUSE LC50; 1449 MG/KG INTRAPERITONEAL-MOUSE LD50; 900 MG/KG ORAL-RABBIT LD50; 4416 PPM/30 MINUTES INHALATION-RABBIT LCLO; 4416 PPM/30 MINUTES INHALATION-GUINEA PIG LCLO; 1000 MG/M3/2 HOURS INHALATION-MAMMAL LCLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYE AND INGESTION.
ACUTE TOXICITY LEVEL: MODERATELY TOXIC BY INHALATION.
TARGET EFFECTS: NO DATA AVAILABLE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE. 100 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INHALATION OF GAS OR FUMES AT LEVELS OF 5-35 PPM MAY CAUSE IRRITATION AND BURNING OF THE THROAT, COUGHING AND CHOKING; 50-100 PPM MAY BE BARELY TOLERABLE FOR 1 HOUR. HIGH LEVELS MAY CAUSE INFLAMMATION AND OCCASIONALLY ULCERATION OF THE NOSE, THROAT OR LARYNX, BRONCHITIS, PNEUMONIA, PALPITATIONS AND HEADACHE. HIGHER CONCENTRATIONS MAY CAUSE NECROSIS OF THE TRACHEAL AND BRONCHIAL EPITHELIUM, NASOSEPTAL PERFORATION, ATELECTASIS, EMPHYSEMA, DAMAGE TO PULMONARY BLOOD VESSELS AND LESIONS OF THE LIVER AND OTHER ORGANS. DEATH MAY BE DUE TO LARYNGEAL SPASM, BRONCHOPNEUMONIA OR PULMONARY EDEMA. 1300-2000 PPM MAY BE DANGEROUS, EVEN ON BRIEF EXPOSURES. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE EROSION AND DISCOLORATION OF EXPOSED TEETH, CHRONIC BRONCHITIS AND GASTRITIS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE.
ACUTE EXPOSURE- CONTACT MAY CAUSE SEVERE IRRITATION, INFLAMMATION, ULCERATION, NECROSIS AND CHEMICAL BURNS. SHOCK SYMPTOMS MAY DEVELOP INCLUDING RAPID PULSE, SWEATING AND COLLAPSE. PHOTOSENSITIZATION REACTIONS MAY OCCUR IN PERSONS PREVIOUSLY EXPOSED. CONTACT WITH A COMPRESSED GAS MAY CAUSE FROSTBITE.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH VAPORS OR DILUTE SOLUTIONS MAY CAUSE DERMATITIS. PHOTOSENSITIZATION MAY OCCUR.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

CORROSIVE.
ACUTE EXPOSURE- CONTACT MAY CAUSE SEVERE IRRITATION, CONJUNCTIVITIS, CORNEAL NECROSIS AND BURNS WITH IMPAIRMENT OR PERMANENT LOSS OF VISION. A DROP OF HYDROCHLORIC ACID SPLASHED IN THE EYE AND IMMEDIATELY WASHED OUT HAS PRODUCED A WHITE COAGULATION OF THE CORNEAL AND CONJUNCTIVAL EPITHELIUM. ANIMALS EXPOSED TO VAPOR CONCENTRATIONS OF 1350 PPM FOR ONE AND A HALF HOURS SHOWED CLOUDING OF THE CORNEA AND 300 PPM FOR 6 HOURS SHOWED SLIGHT EROSION OF THE CORNEAL EPITHELIUM. CONTACT WITH A COMPRESSED GAS MAY CAUSE FROSTBITE.
CHRONIC EXPOSURE- ANIMALS EXPOSED TO VAPOR AT 100 PPM FOR 6 HOURS DAILY FOR 50 DAYS SHOWED ONLY SLIGHT UNREST AND IRRITATION OF THE EYES, BUT NO OCULAR INJURY. EFFECTS ARE DEPENDENT UPON CONCENTRATION AND DURATION OF EXPOSURE. CONJUNCTIVITIS OR EFFECTS SIMILAR TO THOSE FOR ACUTE EXPOSURE MAY OCCUR.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE.
ACUTE EXPOSURE- INGESTION OF THE ACID MAY CAUSE BURNS OF THE MOUTH, THROAT, ESOPHAGUS AND STOMACH WITH CONSEQUENT PAIN, UNEASINESS, NAUSEA, SALIVATION, VOMITING, DIARRHEA, CHILLS, SHOCK AND INTENSE THIRST. NEPHRITIS, FEVER AND PERFORATION OF THE INTESTINAL TRACT, AND CIRCULATORY COLLAPSE MAY OCCUR. DEATH MAY BE DUE TO ESOPHAGEAL OR GASTRIC NECROSIS.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- DO NOT USE GASTRIC LAVAGE OR EMESIS. DILUTE THE ACID IMMEDIATELY BY DRINKING LARGE QUANTITIES OF WATER OR MILK. IF VOMITING PERSISTS, ADMINISTER FLUIDS REPEATEDLY. INGESTED ACID MUST BE DILUTED APPROXIMATELY 100 FOLD TO RENDER IT HARMLESS TO TISSUES. MAINTAIN AIRWAY AND TREAT SHOCK. (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
REACTS EXOTHERMICALLY WITH WATER OR STEAM TO PRODUCE TOXIC AND CORROSIVE FUMES.

CONTACT WITH COMMON METALS PRODUCES HYDROGEN WHICH MAY FORM EXPLOSIVE MIXTURES WITH AIR.

INCOMPATIBILITIES:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
ACETIC ANHYDRIDE: VIOLENT REACTION.
ALCOHOLIC HYDROGEN CYANIDE: EXPLOSIVE REACTION.
ALUMINUM: EXPLOSION.
ALUMINUM-TITANIUM ALLOYS: IGNITES OR INCANDESCES WHEN HEATED.
2-AMINOETHANOL: VIOLENT REACTION.
AMMONIUM HYDROXIDE: VIOLENT REACTION.
BASES: VIOLENT REACTION.
BRASS: CORRODES.
BRONZE: CORRODES.
CALCIUM CARBIDE: REACTS WITH INCANDESCENCE.
CALCIUM HYPOCHLORITE: IGNITION.
CESIUM ACETYLIDE: IGNITES ON CONTACT.
CHLORINE + DINITROANILINES: VIGOROUS REACTION WITH RELEASE OF FLAMMABLE HYDROGEN GAS FUMES.
CHLOROSULFONIC ACID: VIOLENT REACTION.
1,1-DIFLUOROETHYLENE: EXTREMELY EXOTHERMIC DECOMPOSITION REACTION.
DOWICIL 100: DECOMPOSES.
ETHYLENE DIAMINE: VIOLENT REACTION.
ETHYLENE IMINE: VIOLENT REACTION.
FLUORINE: IGNITES ON CONTACT.
HEXALITHIUM DISILICIDE: INCANDESCES.
IRON: CORRODES WITH EVOLUTION OF FLAMMABLE HYDROGEN GAS.
MAGNESIUM BORIDE: PRODUCES A SPONTANEOUSLY FLAMMABLE GAS.
MERCURIC SULFATE: VIOLENT REACTION AT 125 C.
METAL ACETYLIDES: VIOLENT REACTION.
METALS: SEVERE CORROSION WITH EVOLUTION OF FLAMMABLE HYDROGEN GAS.
OLEUM: VIOLENT REACTION.
OXIDIZERS (STRONG): VIOLENT REACTION.
OXYGEN + PLATINUM: IGNITES ON CONTACT.
PERCHLORIC ACID: VIOLENT REACTION.
PLASTICS, RUBBER, COATINGS: ATTACKS.
POTASSIUM PERMANGANATE: EXPLOSION HAZARD.
BETA-PROPIOLACTONE: VIOLENT REACTION.
PROPYLENE OXIDE: VIOLENT REACTION.
RUBIDIUM ACETYLIDE: IGNITES ON CONTACT.
SILICA (GEL): INCOMPATIBLE.

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SODIUM: VIGOROUS OR EXPLOSIVE REACTION.
SULFURIC ACID: EXPLOSIVE REACTION WITH RELEASE OF TOXIC HYDROGEN CHLORIDE GAS.
TETRASELENIUM TETRANITRIDE: EXPLODES ON CONTACT.
VINYL ACETATE: VIOLENT REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE CORROSIVE HYDROGEN CHLORIDE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

##STORAGE##

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

PROTECT AGAINST PHYSICAL DAMAGE. STORE IN COOL, WELL-VENTILATED PLACE, SEPARATED FROM ALL OXIDIZING MATERIALS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

##

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. MAY IGNITE COMBUSTIBLES (WOOD, PAPER, OIL, ETC.).

##

SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

USE CEMENT POWDER OR FLY ASH TO ABSORB LIQUID MASS.

NEUTRALIZE SPILL WITH SLAKED LIME, SODIUM BICARBONATE OR CRUSHED LIMESTONE.

AIR SPILL:
KNOCK DOWN VAPORS WITH WATER SPRAY. KEEP UPWIND.

WATER USED TO KNOCK DOWN VAPORS MAY BECOME CORROSIVE OR TOXIC AND SHOULD BE CONTAINED PROPERLY FOR LATER DISPOSAL.

WATER SPILL:
NEUTRALIZE WITH AGRICULTURAL LIME, SLAKED LIME, CRUSHED LIMESTONE, OR SODIUM BICARBONATE.

OCCUPATIONAL SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 1 POUND
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

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RESPIRATOR:
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON INFORMATION FOUND IN THE PHYSICAL DATA, TOXICITY AND HEALTH EFFECTS SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

50 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH CARTRIDGE(S) PROVIDING PROTECTION AGAINST HYDROCHLORIC ACID.
ANY POWERED AIR-PURIFYING RESPIRATOR WITH CARTRIDGE(S) PROVIDING PROTECTION AGAINST HYDROCHLORIC ACID.

100 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ACID GAS CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

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

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC, INC.
CREATION DATE: 04/30/85 REVISION DATE: 09/06/89

-ADDITIONAL INFORMATION-

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Baxter

Baxter Healthcare Corporation
Burdick & Jackson Division
1953 South Harvey Street
Muskegon, MI 49442 USA

information/emergency telephone no. 616.726.3171
chemtrec telephone no. 800.424.9300
canadian emergency telephone no. 613.996.6666

MATERIAL SAFETY DATA SHEET

METHANOL

I. Identification

chemical name: Methanol — molecular weight: 32.04
chemical family: Alcohol — formula: CH_4O
synonyms: Carbinol, Methyl Alcohol, Wood Alcohol
DOT proper shipping name: Methyl Alcohol or Methanol
DOT hazard class: Flammable Liquid
DOT identification no.: UN1230 — CAS no.: 67-56-1

II. Physical and Chemical Data

boiling point, 760mm Hg: 64.7°C — freezing point: -97.7°C — evaporation rate: (BuAc=1) ca 5
vapor pressure at 20°C: 97 mm Hg — vapor density (air=1): 1.11 — solubility in water: @ 20°C complete
% volatiles by volume: ca 100 — specific gravity (H_2O=1): @ 20°C 0.792 — stability: Stable
hazardous polymerization: Not expected to occur.
appearance and odor: A clear, colorless liquid with a slight alcoholic odor.
conditions to avoid: Heat, sparks, open flame, open containers, and poor ventilation.

materials to avoid: Strong oxidizing agents and reactive metals which will displace hydrogen.

hazardous decomposition products: Incomplete combustion can generate carbon monoxide and other toxic vapors such as formaldehyde.

III. Fire and Explosion Hazard Data

flash point, (test method): 12°C (Tag closed cup) — auto ignition temperature: 385°C
flammable limits in air % by volume: lower limit: 6.7 — upper limit: 36.5
unusual fire and explosion hazards: May burn with an invisible flame. Mixtures with water as low as 21% by volume are still flammable (flash point below 37.8°C). Under some circumstances can corrode certain metals, including aluminum and zinc, and generate hydrogen gas.
extinguishing media: Carbon dioxide, dry chemical, alcohol foam, water mist or fog.

special fire fighting procedures: Wear full protective clothing and self-contained breathing apparatus. Heat will build pressure and may rupture closed storage containers. Keep fire-exposed containers cool with water spray.

IV. Hazardous Components

	%	TLV	CAS no.
Methanol	ca 100	200 ppm (skin)	67-56-1

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V. Health Hazards

Occupational Exposure Limits

OSHA	TWA	- 200 ppm
	STEL	- 250 ppm
	Ceiling	- not listed
ACGIH	TLV-TWA	- 200 ppm
	TLV-STEL	- 250 ppm
NIOSH	10 hour TWA	- 200 ppm
	15 min Ceiling	- 800 ppm

Concentration Immediately Dangerous to Health

OSHA/NIOSH	25,000 ppm

Odor Threshold

NSC	10 ppm
NIOSH	2000 ppm

Carcinogenic Data

Methanol is not listed as a carcinogen by IARC, NTP, OSHA, or ACGIH.

Primary Routes of Entry

Methanol may exert its effects through inhalation, skin absorption, and ingestion.

Industrial Exposure: Route of Exposure/Signs and Symptoms

Inhalation: Exposure can cause drowsiness and intoxication, headache, visual disturbance leading to blindness, coughing and shortness of breath, collapse and death at high concentrations.

Eye Contact: Liquid can cause moderate burning, watering, swelling, and redness; high vapor concentration (greater than 2000 ppm) may cause same symptoms.

Skin Contact: This substance may be absorbed through intact skin and produce toxic effects. Extensive, repeated and/or prolonged skin contact can cause burning, itching, redness, or blisters.

Ingestion: Causes burning of the gastrointestinal tract and toxic effects. Swallowing more than 2 ounces of methanol can cause death.

Effects of Overexposure

Mild poisoning is characterized by fatigue, nausea, headache, and delayed visual blurring. Moderate intoxication results in severe depression. Temporary or permanent blindness may follow in 2-6 days. In severe poisoning, symptoms progress to rapid, shallow respiration, cyanosis, coma, hypotension, dilated pupils, and visual disturbance. Death may result from respiratory failure.

Medical Condition Aggravated by Exposure

Preclude from exposure those individuals with diseases of eyes, liver, kidneys, and lungs.

Emergency First Aid

Inhalation: Immediately remove to fresh air. If not breathing, administer mouth-to-mouth rescue breathing. If there is no pulse administer cardiopulmonary resuscitation (CPR). Contact physician immediately.

Eye Contact: Rinse with copious amounts of water for at least 15 minutes. Get emergency medical assistance.

Skin Contact: Flush thoroughly for at least 15 minutes. Wash affected skin with soap and water. Remove contaminated clothing and shoes. Wash clothing before re-use, and discard contaminated shoes. Get emergency medical assistance.

Ingestion: Call local Poison Control Center for assistance. Contact physician immediately. Never induce vomiting or give anything by mouth to a victim unconscious or having convulsions.

Note to Physician

In case of ingestion or massive inhalation, observe victim as an inpatient because slow metabolism causes a latent period of 24 hours between exposure and acidosis and blindness.

VI. Safety Measures and Equipment

Ventilation: Adequate ventilation is required to protect personnel from exposure to chemical vapors exceeding the PEL and to minimize fire hazards. The choice of ventilation equipment, either local or general, will depend on the conditions of use, quantity of material, and other operating parameters.

Respiratory: Use approved respirator equipment. Follow NIOSH and equipment manufacturer's recommendations to determine appropriate equipment (air-purifying, air-supplied, or self-contained breathing apparatus).

Eyes: Safety glasses are considered minimum protection. Goggles or face shield may be necessary depending on quantity of material and conditions of use.

Skin: Protective gloves and clothing are recommended. The choice of material must be based on chemical resistance and other user requirements. Generally, neoprene, nitrile rubber, or rubber offer acceptable chemical resistance. Individuals who are acutely and specifically sensitive to methanol may require additional protective equipment.

Storage: Methanol should be protected from temperature extremes and direct sunlight. Proper storage of methanol must be determined based on other materials stored and their hazards and potential chemical incompatibility. In general, methanol should be stored in an acceptably protected and secure flammable liquid storage room.

Other: Emergency eye wash fountains and safety showers should be available in the vicinity of any potential exposure. Ground and bond metal containers to minimize static sparks.

VII. Spill and Disposal Data

Spill Control: Protect from ignition. Wear protective clothing and use approved respirator equipment. Absorb spilled material in an absorbent recommended for solvent spills and remove to a safe location for disposal by approved methods. If released to the environment, comply with all regulatory notification requirements.
CERCLA Reportable Quantity — 5,000 lbs.

Waste Disposal: Dispose of methanol as an EPA hazardous waste. Contact state environmental agency for listing of licensed hazardous waste disposal facilities and applicable regulations. Hazardous waste numbers: U154(Ignitable); D001(Ignitable).

VIII. SARA/Title III Data

Hazard Classification	
Immediate Health	Yes
Delayed Health	Yes
Fire	Yes
Sudden Release	No
Reactive	No

Chemical Listings	
Extremely Hazardous Substances	No
CERCLA Hazardous Substances	Yes
Toxic Chemicals	Yes

Methanol is subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) and 40CFR Part 372. This product does not contain any other toxic chemical above 1% concentration or a carcinogen above 0.1% concentration.

Revision Date: July, 1989

KEY

ca	Approximately	STEL	Short Term Exposure Level (15 minutes)
na	Not applicable	TLV	Threshold Limit Value
C	Ceiling	TWA	Time Weighted Average (8 hours)
		BuAc	Butyl Acetate

CERCLA Comprehensive Environmental Response, Compensation and Liability Act
NSC National Safety Council ("Fundamentals of Industrial Hygiene," 3rd Ed., 1988)

U.S. EPA Quality Assurance Materials Bank
Multicomponents Standard Contents Table

VOLATILE COMPOUNDS IX

Standard Code: C-045-02 Solvent: Methanol

NSI-ES Code Number	Compound	Concentration* (μg/mL)
EC-000046	Bromodichloromethane	2000
EC-000200	Dibromochloromethane	2000
EC-000009	1,2-Dichloroethane	2000
EC-000028	trans-1,2-Dichloroethene	2000
EV-000218	cis-1,3-Dichloropropene	2800
EV-000451	trans-1,3-Dichloropropene	2300
EC-000042	Methylene chloride	2000
EC-000083	1,1,2,2-Tetrachloroethylene	2000
EC-000010	1,1,1-Trichloroethane	2000
EC-000047	Trichlorofluoromethane	2000
EC-000536	Vinyl chloride	2000

*Concentration corrected for purity.

Revised: March 1988

American Burdick & Jackson

Material Safety Data Sheet

MATERIAL SAFETY DATA SHEET

METHANOL

emergency telephone no 312/973-3600 (American Scientific Products)
chemtrec telephone no 800/424-9300
information telephone no 616/726-3171 (American Burdick & Jackson)

I. Identification

chemical name Methanol — molecular weight 32.04
chemical family Alcohol — formula CH_4O
synonyms Carbinol, Methyl Alcohol, Wood Alcohol
DOT proper shipping name Methyl Alcohol or Methanol
DOT hazard class Flammable Liquid
DOT identification no UN1230 — CAS no 67-56-1

II. Physical and Chemical Data

boiling point, 760mm Hg 64.7°C — freezing point -97.7°C — evaporation rate (BuAc=1) ca 5
vapor pressure at 20 C 97 mm Hg — vapor density (air = 1) 1.11 — solubility in water @ 20°C complete
% volatiles by volume ca 100 — specific gravity (H_2O = 1) @ 20°C 0.792 — stability Stable
hazardous polymerization Not expected to occur.
appearance and odor A clear, colorless liquid with a slight alcoholic odor.
conditions to avoid Heat, sparks, open flame, open containers, and poor ventilation.

materials to avoid Strong oxidizing agents and reactive metals which will displace hydrogen.

hazardous decomposition products Incomplete combustion can generate carbon monoxide and other toxic vapors such as formaldehyde.

III. Fire and Explosion Hazard Data

flash point, (test method) 12°C (Tag closed cup) — auto ignition temperature 385°C
flammable limits in air % by volume, lower limit 6.0 — upper limit 36.5
unusual fire and explosion hazards May burn with an invisible flame. Mixtures with water as low as 21% by volume are still flammable (flash point below 37.8°C). Under some circumstances can corrode certain metals, including aluminum and zinc, and generate hydrogen gas.
extinguishing media Carbon dioxide, dry chemical, alcohol foam, water mist or fog.

special fire fighting procedures Wear full protective clothing and self-contained breathing apparatus. Heat will build pressure and may rupture closed storage containers. Keep fire-exposed containers cool with water spray.

IV. Hazardous Components

Methanol — % ca 100 — TLV 200 ppm — CAS no 67-56-1

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American Burdick & Jackson — Subsidiary of American Hospital Supply Corporation — 1953 South Harvey Street, Muskegon, MI 49442

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Methanol

V. Health Hazards

Occupational Exposure Limits

OSHA	8-hour PEL	-	200 ppm
	Ceiling	-	not listed
	Peak	-	not listed
ACGIH	TLV-TWA	-	200 ppm
	TLV-STEL (15-min)	-	250 ppm
NIOSH	TLV-TWA	-	200 ppm
	TLV-C	-	800 ppm

Concentration Immediately Dangerous to Health

OSHA/NIOSH	25,000 ppm

Odor Threshold

NSC & OHS	10 ppm
NIOSH	2000 ppm

Carcinogenic, Mutagenic, Teratogenic Data

Positive mutagen (RTEC)

Primary Routes of Entry

Methanol may exert its effects through inhalation, skin absorption, and ingestion.

Industrial Exposure: Route of Exposure/Signs and Symptoms

Inhalation: Exposure can cause drowsiness and intoxication, headache, visual disturbance leading to blindness, coughing and shortness of breath, collapse and death at high concentrations.

Eye Contact: Liquid can cause moderate burning, watering, swelling, and redness; high vapor concentration (greater than 2000 ppm) may cause same symptoms.

Skin Contact: This substance may be absorbed through intact skin and produce toxic effects. Extensive, repeated and/or prolonged skin contact can cause burning, itching, redness, or blisters.

Ingestion: Causes burning of the gastrointestinal tract and toxic effects. Swallowing more than 2 ounces of methanol can cause death.

Effects of Overexposure

Mild poisoning is characterized by fatigue, nausea, headache, and delayed visual blurring. Moderate intoxication results in severe depression. Temporary or permanent blindness may follow in 2-6 days. In severe poisoning, symptoms progress to rapid, shallow respiration, cyanosis, coma, hypotension, dilated pupils, and visual disturbance. Death may result from respiratory failure.

Medical Condition Aggravated by Exposure

Preclude from exposure those individuals with diseases of eyes, liver, kidneys, and lungs.

Emergency First Aid

Inhalation: Immediately remove to fresh air. If not breathing, administer mouth-to-mouth rescue breathing. If there is no pulse administer cardiopulmonary resuscitation (CPR). Contact physician immediately.

Eye Contact: Rinse with copious amounts of water for at least 15 minutes. Get emergency medical assistance.

Skin Contact: Flush thoroughly for at least 15 minutes. Wash affected skin with soap and water. Remove contaminated clothing and shoes. Wash clothing before re-use, and discard contaminated shoes. Get emergency medical assistance.

Ingestion: Call local Poison Control Center for assistance. Contact physician immediately. Never induce vomiting or give anything by mouth to a victim unconscious or having convulsions.

Note to Physician

In case of ingestion or massive inhalation, observe victim as an inpatient because slow metabolism causes a latent period of 24 hours between exposure and acidosis and blindness.

VI. Safety Measures and Equipment

Ventilation: Adequate ventilation is required to protect personnel from exposure to chemical vapors exceeding the PEL and to minimize fire hazards. The choice of ventilation equipment, either local or general, will depend on the conditions of use, quantity of material, and other operating parameters.

Respiratory: Use approved respirator equipment. Follow NIOSH and equipment manufacturer's recommendations to determine appropriate equipment (air-purifying, air-supplied, or self-contained breathing apparatus).

Eyes: Safety glasses are considered minimum protection. Goggles or face shield may be necessary depending on quantity of material and conditions of use.

Skin: Protective gloves and clothing are recommended. The choice of material must be based on chemical resistance and other user requirements. Generally, neoprene or rubber offers acceptable chemical resistance. Individuals who are acutely and specifically sensitive to methanol may require additional protective equipment.

Storage: Methanol should be protected from temperature extremes and direct sunlight. Proper storage of methanol must be determined based on other materials stored and their hazards and potential chemical incompatibility. In general, methanol should be stored in an acceptably protected and secure flammable liquid storage room.

Other: Emergency eye wash fountains and safety showers should be available in the vicinity of any potential exposure. Ground and bond metal containers to minimize static sparks.

VII. Spill and Disposal Data

Spill Control: Protect from ignition. Wear protective clothing and use approved respirator equipment. Absorb spilled material in an absorbent recommended for solvent spills and remove to a safe location for disposal by approved methods. If released to the environment, comply with all regulatory notification requirements.

Waste Disposal: Dispose of methanol as an EPA hazardous waste. Hazardous waste numbers: U154 (ignitable); D001 (ignitable).

Revision Date: 1/85

KEY

ca	Approximately	STEL	Short Term Exposure Level
na	Not applicable	TLV	Threshold Limit Value
C	Ceiling	TWA	Time Weighted Average
PEL	Permissable Exposure Level	BuAc	Butyl Acetate

NSC National Safety Council ("Fundamentals of Industrial Hygiene", 1983)
OHS Occupational Health Services ("Hazardline")

12/14/89

MATERIAL SAFETY DATA SHEET 2.968

SECTION I - NAME AND PRODUCT

MFG NAME AND ADDRESS
EM SCIENCES /MCB
P.O. BOX 3018

CHERRYHILL
NJ 080340399

CHEMICAL NAME :
METHANOL OMNISOLV 1.0GL (4 LT)
TRADE NAME SYN :
METHYL ALCOHOL, WOOD ALCOHOL
CHEMICAL FAMILY :
ALCOHOLS

CHEMICAL NUMBER: MMX0488-1
ITEM NUMBER : 400499
VNDR CATLG NBR :
ENTRY DATE : 08-22-89
CHANGE DATE :
EMERGENCY PHONE: 609 4236300

SECTION II - HAZARDOUS INGREDIENTS

HAZARDOUS COMPONENTS:
REFER TO SECTION 4-9

DOT - FLAMMABLE LIQUID

SECTION III - PHYSICAL DATA S/10 = SEE SECTION X

BOIL. POINT	SPECIFIC GRAVITY	VAPOR PRESS.	MELT. POINT	VAPOR DENSITY	EVAP. RATE	SOLUBLE IN WATER	PERCENT VOLATILE
64.5C	0.79	96	-144F	1.1	5.91 BUTYL ACETATE	SOLBLE	100

APPEARANCE AND ODOR:
COLORLESS LIQUID, SLIGHT ALCOHOLIC ODOR

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 52 DEG. F. (TCC)
FLAMMABLE LEL: 6.7%
FLAMMABLE UEL: 35%

EXTINGUISHING MEDIA:
CO2, DRY CHEMICAL, FOAM, WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.
WATER SPRAY TO DISPERSE VAPORS.
SPECIAL FIRE FIGHTING PROCEDURES:
WEAR SELF-CONTAINED BREATHING APPARATUS

UNUSUAL FIRE AND EXPLOSION HAZARDS:
ADDITION OF WATER TO BURNING FUEL MAY REDUCE INTENSITY OF FLAME.

SECTION V - HEALTH HAZARD DATA

THRESHOLD-LIMIT-VALUE:
OSHA STD-AIR: TWA 200 PPM TXDS: ORL-MAN LDLO: 340 MG/KG

EFFECTS OF OVEREXPOSURE:
HIGHLY TOXIC BY FUMES AND CONTACT; INGESTION MAY BE FATAL AND DAILY CONTACT WILL HAVE CUMLATIVE EFFECT. MAY CAUSE INEBRIATION, NAUSEA, VOMITING; CENTRAL NERVOUS SYSTEM DAMAGE; BLINDNESS; DEFATTING, DRYING AND CRACKING OF THE SKIN.

EMERGENCY AND FIRST AID PROCEDURES:
SKIN: WASH WITH SOAP/WATER; GET MEDICAL ASSISTANCE FOR SKIN IRRITATION.
EYES: FLUSH WITH WATER 15 MINUTES; GET MEDICAL ASSISTANCE.
INHALATION: REMOVE TO FRESH AIR; GET MEDICAL ASSISTANCE.
INGESTION: INDUCE VOMITING IF CONSCIOUS; GET MEDICAL ASSISTANCE.

SECTION VI - REACTIVITY DATA

INDICATORS: STABILITY - STABLE POLYMERIZATION - MAY NOT OCCUR

CONDITIONS TO AVOID:
HEAT, SPARKS, OPEN FLAME

INCOMPATIBILITY (MATL TO AVOID):
OXIDIZERS

HAZARDOUS DECOMPOSITION OR BY PRODUCTS:
COX

POLYMERIZATION CONTIONS TO AVOID:
N/A

SECTION VII - SPILL OR LEAK PROCEDURES OR DISPOSAL

MATERIAL RELEASE OR SPILL PROCEDURES:

EVACUATE NON-ESSENTIAL PERSONNEL. ABSORB WITH SAND.

WASTE DISPOSAL METHOD:

TO BE PERFORMED IN COMPLIANCE WITH ALL CURRENT LOCAL, STATE, AND FEDERAL REGULATIONS.

12/14/89

MATERIAL SAFETY DATA SHEET 2.968

SECTION VIII- SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:
WEAR AIR-SUPPLIED MASK. DO NOT BREATHE VAPOR.
VENTILATION - LOCAL:
PROVIDE ADEQUATE GENERAL MECHANICAL AND LOCAL EXHAUST VENTILATION.
VENTILATION - MECHANICAL:
N/A
VENTILATION - SPECIAL:
N/A
OTHER
DO NOT GET IN EYES OR ON CLOTHING. FACE SHIELD MAY BE NECESSARY
PROTECTIVE GLOVES:
SAFETY GLOVES
EYE PROTECTION:
SAFETY GOGGLES

SECTION IX - SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:
KEEP CONTAINER TIGHTLY CLOSED. NO SMOKING OR FLARES. STORE IN A WELL-VENTILATED AREA, AWAY FROM SOURCES OF IGNITION. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. IF INGESTED, CAN CAUSE BLINDNESS; CANNOT BE MADE NON-POISONOUS.

SECTION X - OTHER INFORMATION

NFPA 704:	1	3	0
	HEALTH	FLAMMABILITY	REACTIVITY

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ATTN: SAFETY DIRECTOR
FRANK MILLER
ABBOTT LABORATORIES
DEPT 57Y AP6C
ABBOTT PARL IL 60064

DATE: 11/02/88

CUST#: 6-025-00280 PO#:

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: M1770 NAME: METHANOL PROTEIN SEQUENCING GRADE
CAS #: 67-56-1
MF: CH4O

SYNONYMS
ALCOOL METHYLIQUE (FRENCH) * ALCOOL METILICO (ITALIAN) * CARBINOL * COLONIAL SPIRIT * COLUMBIAN SPIRIT * COLUMBIAN SPIRITS (DOT) * METHANOL (DOT) * METANOLO (ITALIAN) * METHYL ALCOHOL * METHYL ALCOHOL (ACGIH,DOT) * METHYLOL * METHYLALKOHOL (GERMAN) * METHYL HYDRATE * METHYL HYDROXIDE * METYLOWY ALKOHOL (POLISH) * MONOHYDROXYMETHANE * PYROXYLIC SPIRIT * RCRA WASTE NUMBER U154 * UN 1230 (DOT) * WOOD ALCOHOL * WOOD ALCOHOL (DOT) * WOOD NAPHTHA * WOOD SPIRIT *

TOXICITY HAZARDS

RTECS NO: PC1400000
METHANOL
CITATION DATA

SKN-RBT 20 MG/24H MOD	85JCAE -,187,86
EYE-RBT 40 MG MOD	UCDS** 3/24/70
EYE-RBT 100 MG/24H MOD	85JCAE -,187,86

TOXICITY DATA

ORL-MAN LDLO:6422 UG/KG	CMAJAX 128,14,83
ORL-HMN LDLO:428 MG/KG	NPIRI* 1,74,74
ORL-HMN LDLO:143 MG/KG	34ZIAG -,382,69
UNR-MAN LDLO:868 MG/KG	85DCAI 2,73,70
ORL-RAT LD50:5628 MG/KG	GTPZAB 19(11),27,75
IHL-RAT LC50:64000 PPM/4H	NPIRI* 1,74,74
IPR-RAT LD50:7529 MG/KG	EVHPAZ 61,321,85
IVN-RAT LD50:2131 MG/KG	EVHPAZ 61,321,85
ORL-MUS LD50:7300 MG/KG	TXCYAC 25,271,82
IPR-MUS LD50:10765 MG/KG	EVHPAZ 61,321,85
SCU-MUS LD50:9800 MG/KG	TXAPA9 18,185,71
IVN-MUS LD50:4710 MG/KG	EVHPAZ 61,321,85
ORL-MKY LD50:7 GM/KG	TXAPA9 3,202,61
ORL-RBT LD50:14200 MG/KG	FAONAU 48A,105,70
SKN-RBT LD50:15800 MG/KG	NPIRI* 1,74,74
IPR-RBT LD50:1826 MG/KG	EVHPAZ 61,321,85
IVN-RBT LD50:8907 MG/KG	EVHPAZ 61,321,85
IPR-GPG LD50:3556 MG/KG	EVHPAZ 61,321,85
IPR-HAM LD50:8555 MG/KG	EVHPAZ 61,321,85

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 200 PPM; STEL 250 PPM (SKIN) 85INA8 5,372,86
MSHA STANDARD-AIR:TWA 200 PPM (260 MG/M3) (SKIN) DTLVS* 3,155,71
OSHA STANDARD-AIR:TWA 200 PPM FEREAC 39,23540,74
NIOSH REL TO METHYL ALCOHOL-AIR:TWA 200 PPM;CL 800 PPM/15M MMWR** 34(1S),21S,85
EPA GENETOX PROGRAM 1986, NEGATIVE: SHE-CLONAL ASSAY; CELL TRANSFORM.-SA7/SHE
EPA GENETOX PROGRAM 1986, NEGATIVE: N CRASSA-ANEUPLOIDY; IN VITRO SCE-

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17A

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CUST#: 6-025-00280 PO#:

PRODUCT #: M1770 NAME : METHANOL PROTEIN SEQUENCING GRADE

TOXICITY HAZARDS

NONHUMAN
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 3(E) STATUS REPORT 8EHQ-0378-0108
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, MARCH 1988
NIOSH ANALYTICAL METHODS: SEE METHANOL, 2000
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

TARGET ORGAN DATA
BRAIN AND COVERINGS (CHANGES IN CIRCULATION)
SENSE ORGANS AND SPECIAL SENSES (OPTIC NERVE NEUROPATHY)
SENSE ORGANS AND SPECIAL SENSES (VISUAL FIELD CHANGES)
BEHAVIORAL (HEADACHE)
LUNGS, THORAX OR RESPIRATION (DYSPNAE)
LUNGS, THORAX OR RESPIRATION (OTHER CHANGES)
GASTROINTESTINAL (NAUSEA OR VOMITING)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF SWALLOWED.
HARMFUL IF INHALED OR ABSORBED THROUGH SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
EXPOSURE CAN CAUSE:
DAMAGE TO THE EYES
DAMAGE TO THE LIVER
DAMAGE TO THE HEART
DAMAGE TO THE KIDNEYS
GASTROINTESTINAL DISTURBANCES
MAY CAUSE CONVULSIONS.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
DISCARD CONTAMINATED CLOTHING AND SHOES.

SECTION 3 FOOTNOTES
METHYL ALCOHOL MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. CANNOT BE MADE NON-POISONOUS.

PHYSICAL DATA

BOILING PT: 64.6 C

CONTINUED ON NEXT PAGE

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MATERIAL SAFETY DATA SHEET

CUST#: 6-025-00280 PO#:

PRODUCT #: M1770 NAME : METHANOL PROTEIN SEQUENCING GRADE

PHYSICAL DATA

MELTING PT: -98 C
SPECIFIC GRAVITY: 0.791
VAPOR DENSITY: 1.1
VAPOR PRESSURE: 97.68 MM @ 20 C

FIRE AND EXPLOSION HAZARD DATA

FLASHPOINT: 52 F
AUTOIGNITION TEMPERATURE: 725 F
LOWER EXPLOSION LEVEL: 6%
UPPER EXPLOSION LEVEL: 36%

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EXTREMELY FLAMMABLE.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.

REACTIVITY DATA

INCOMPATIBILITIES
ACIDS
ACID CHLORIDES
ACID ANHYDRIDES
OXIDIZING AGENTS
REDUCING AGENTS
ALKALI METALS

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE AND CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH, PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD
BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH-MSHA-APPROVED RESPIRATOR, CHEMICAL

CONTINUED ON NEXT PAGE

17C

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MATERIAL SAFETY DATA SHEET

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PRODUCT #: M1770 NAME : METHANOL PROTEIN SEQUENCING GRADE

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
MECHANICAL EXHAUST REQUIRED.
SAFETY SHOWER AND EYE BATH.
DO NOT BREATHE VAPOR.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
DO NOT USE IF SKIN IS CUT OR SCRATCHED. WASH THOROUGHLY AFTER HANDLING.
POISON
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
HYGROSCOPIC
STORE IN A COOL DRY PLACE.

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METHANOL
METHANOL
METHANOL

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-56-1

SUBSTANCE: **METHANOL**

TRADE NAMES/SYNONYMS:
METHYL ALCOHOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE; WOOD SPIRIT; WOOD NAPHTHA; METHYLOL; COLONIAL SPIRIT; COLUMBIAN SPIRIT; PYROXYLIC SPIRIT; STCC 4909230; UN 1230; RCRA U154; CH4O; A-454; A-452; A-936; A-408; A-947; A-935; A-412; A-411; A-433P; SW-2; SC-95; ACC14280

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C-H3-O-H

MOLECULAR WEIGHT: 32.04

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: METHYL ALCOHOL (METHANOL) PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
METHYL ALCOHOL (METHANOL):
200 PPM (260 MG/M3) OSHA TWA
200 PPM (260 MG/M3) ACGIH TWA (SKIN); 250 PPM (310 MG/M3) ACGIH STEL
200 PPM NIOSH RECOMMEDED 10 HOUR TWA
800 PPM NIOSH RECOMMENDED 15 MINUTE CEILING

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS LIQUID WITH A CHARACTERISTIC ALCOHOLIC ODOR.

BOILING POINT: 149 F (65 C) MELTING POINT: -137 F (-94 C)

SPECIFIC GRAVITY: 0.7914 VAPOR PRESSURE: 97.25 MMHG @ 20 C

EVAPORATION RATE: (BUTYL ACETATE=1) 4.6 SOLUBILITY IN WATER: VERY SOLUBLE

ODOR THRESHOLD: 100 PPM VAPOR DENSITY: 1.11

SOLVENT SOLUBILITY: ETHER, BENZENE, ALCOHOL, ACETONE, CHLOROFORM, ETHANOL.

VISCOSITY: 0.59 CPS @ 20 C

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT, FLAME, OR OXIDIZERS.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

VAPOR-AIR MIXTURES ARE EXPLOSIVE.

FLASH POINT: 52 F (11 C) (CC) UPPER EXPLOSIVE LIMIT: 36.0%

LOWER EXPLOSIVE LIMIT: 6.0% AUTOIGNITION TEMP.: 725 F (385 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT # 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM

(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL; DO NOT SCATTER THE MATERIAL. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 28).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG. SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: 49CFR173.118

TOXICITY

METHYL ALCOHOL (METHANOL):
20 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 40 MG EYE-RABBIT MODERATE IRRITATION; 100 MG/24 HOURS EYE-RABBIT MODERATE IRRITATION; 86000 MG/M3 INHALATION-HUMAN TCLO; 300 PPM INHALATION-HUMAN TCLO; 64000 PPM/4 HOURS INHALATION-RAT LC50; 1000 PPM INHALATION-MONKEY LCLO; 50 GM/M3/2 HOURS INHALATION-MOUSE LCLO; 44000 MG/M3/6 HOURS INHALATION-CAT LCLO; 15800 MG/KG SKIN-RABBIT LD50; 393 MG/KG SKIN-MONKEY LDLO; 428 MG/KG ORAL-HUMAN LDLO; 143 MG/KG ORAL-HUMAN LDLO; 6422 UG/KG ORAL-MAN LDLO; 3429 MG/KG ORAL-MAN TDLO; 4 GM/KG ORAL-WOMAN TDLO; 7 GM/KG ORAL-MONKEY LD50; 5628 MG/KG ORAL-RAT LD50; 7300 MG/KG ORAL-MOUSE LD50; 14200 MG/KG ORAL-RABBIT LD50; 868 MG/KG UNREPORTED-MAN LDLO; 7529 MG/KG INTRAPERITONEAL-RAT LD50; 10765 MG/KG INTRAPERITONEAL-MOUSE LD50; 1826 MG/KG INTRAPERITONEAL-RABBIT LD50; 9800 MG/KG SUBCUTANEOUS-MOUSE LD50; 2131 MG/KG INTRAVENOUS-RAT LD50; 4710 MG/KG INTRAVENOUS-MOUSE LD50; 8907 MG/KG INTRAVENOUS-RABBIT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
METHYL ALCOHOL IS AN EYE AND SKIN IRRITANT, NEUROTOXIN, AND A CENTRAL NERVOUS SYSTEM DEPRESSANT. PERSONS WITH CHRONIC RESPIRATORY, LIVER, KIDNEY, EYE, OR SKIN DISEASES MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
METHYL ALCOHOL (METHANOL):
NARCOTIC/NEUROTOXIN. 25,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INTOXICATION MAY RESULT IN A STATE OF INEBRIATION. WITHIN 12-18 HOURS, COUGHING, HEADACHE, TINNITUS, DULLNESS, ANOREXIA, WEAKNESS, VERTIGO, FATIGUE, RESTLESSNESS, INSOMNIA, AND LEG CRAMPS MAY OCCUR, FOLLOWED BY NAUSEA, VOMITING, COLIC, CONSTIPATION, VIOLENT PAIN IN THE BACK, ABDOMEN, AND EXTREMITIES, MUSCULAR INCOORDINATION, SWEATING, COLD, CLAMMY EXTREMITIES, DYSPNEA, AND OTHER SIGNS OF NARCOSIS, THEN TRACHEITIS, BRONCHITIS, AND BLEPHAROSPASM. APATHY OR DELIRIUM MAY PROGRESS TO COMA. EXCITEMENT, MANIA, AND CONVULSIONS RARELY OCCUR. BLURRED OR DIMMED VISION WITH OPTIC NEURITIS, NYSTAGMUS, DILATED, UNRESPONSIVE PUPILS, EYE PAIN, CONCENTRIC CONSTRICTION OF VISUAL FIELDS, PHOTOPHOBIA, AND OPTIC NERVE ATROPHY, FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS MAY OCCUR. ACIDOSIS MAY RESULT IN RAPID AND SHALLOW RESPIRATION, CYANOSIS, COMA, AND HYPOTENSION. MILD TACHYCARDIA, CARDIAC DEPRESSION, AND PERIPHERAL NEURITIS ARE POSSIBLE, AS WELL AS LIVER AND KIDNEY DAMAGE, AND CEREBRAL AND PULMONARY EDEMA. DEATH IS POSSIBLE FROM RESPIRATORY FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION MAY BE DELAYED. IRREVERSIBLE CENTRAL NERVOUS SYSTEM EFFECTS INCLUDING MOTOR DYSFUNCTION WITH RIGIDITY, SPASTICITY, AND HYPOKINESIS HAVE BEEN REPORTED.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE SYMPTOMS SUCH AS VISUAL IMPAIRMENT, POSSIBLY BLINDNESS, AND OTHER EFFECTS AS IN ACUTE EXPOSURE. REPEATED IN EXPOSURE TO 200-375 PPM CAUSED RECURRENT HEADACHES IN WORKERS. EXPOSURE FOR 4 YEARS TO 1200-8000 PPM RESULTED IN MARKED DIMINUTION OF VISION AND ENLARGEMENT OF THE LIVER IN A WORKMAN. FETAL DEVELOPMENTAL ABNORMALITIES AND EFFECTS ON THE EMBRYO OR FETUS HAVE BEEN REPORTED FROM PROLONGED EXPOSURE TO METHYL ALCOHOL BY PREGNANT RATS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
METHYL ALCOHOL (METHANOL):
IRRITANT/NARCOTIC/NEUROTOXIN.
ACUTE EXPOSURE- CONTACT WITH LIQUID MAY CAUSE IRRITATION. IT MAY BE ABSORBED THROUGH THE SKIN TO CAUSE SYSTEMIC EFFECTS INCLUDING CENTRAL NERVOUS SYSTEM DEPRESSION, NARCOSIS, OPTIC NEURITIS, AND ACIDOSIS. LETHAL AMOUNTS MAY BE ABSORBED THROUGH INTACT SKIN.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH THE LIQUID MAY CAUSE DEFATTING OF THE SKIN RESULTING IN ERYTHEMA, SCALING, AND ECZEMATOID DERMATITIS. CHRONIC ABSORPTION MAY RESULT IN VISUAL IMPAIRMENT AND OPTIC

NEURITIS AND OTHER EFFECTS AS IN ACUTE EXPOSURE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
METHYL ALCOHOL (METHANOL):
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT WITH THE DILUTED SOLUTIONS MAY CAUSE MILD IRRITATION AND THE UNDILUTED LIQUID MAY CAUSE MODERATE CORNEAL OPACITY AND CONJUNCTIVAL REDNESS IN RABBITS. APPLICATION OF A DROP OF METHANOL IN RABBITS' EYES CAUSED A MILD REVERSIBLE REACTION, GRADED 3 ON A SCALE OF 1-10 AFTER 24 HOURS. INGESTION, INHALATION, OR SKIN ABSORPTION MAY RESULT IN BLURRED OR DIMMED VISION WITH OPTIC NEURITIS, EYE PAIN, ATROPHY, CONCENTRIC VISUAL FIELDS, AND PHOTOPHOBIA, FOLLOWED BY TRANSIENT OR PERMANENT, COMPLETE OR BILATERAL BLINDNESS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS. VISUAL IMPAIRMENT AS DESCRIBED ABOVE MAY INDICATE CHRONIC EXPOSURE BY INGESTION, INHALATION OR SKIN ABSORPTION.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
METHYL ALCOHOL (METHANOL):
NARCOTIC/NEUROTOXIN.
ACUTE EXPOSURE- SYMPTOMS MAY BE DELAYED 12-18 HOURS AND MAY INCLUDE COUGHING, HEADACHE, DULLNESS, VERTIGO, ANOREXIA, WEAKNESS, FATIGUE, RESTLESSNESS, INSOMNIA, AND LEG CRAMPS, FOLLOWED BY NAUSEA, OCCASIONAL VOMITING AND DIARRHEA, VIOLENT PAIN IN THE BACK, ABDOMEN, AND EXTREMITIES, MUSCULAR INCOORDINATION, SWEATING, COLD AND CLAMMY EXTREMITIES, DYSPNEA, AND OTHER SIGNS OF NARCOSIS MAY OCCUR. APATHY OR DELIRIUM MAY PROGRESS TO COMA. EXCITEMENT, MANIA, AND CONVULSIONS HAVE OCCURRED RARELY. BLURRED OR DIMMED VISION WITH OPTIC NEURITIS, DILATED, UNRESPONSIVE PUPILS, EYE PAIN, CONCENTRIC CONSTRICTION OF VISUAL FIELDS, PHOTOPHOBIA, AND OPTIC NERVE ATROPHY, FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS MAY OCCUR. ACIDOSIS MAY RESULT IN RAPID, SHALLOW RESPIRATION, CYANOSIS, COMA, AND HYPOTENSION. MILD TACHYCARDIA, CARDIAC DEPRESSION, AND PERIPHERAL NEURITIS ARE POSSIBLE, AS WELL AS LIVER AND KIDNEY DAMAGE, AND CEREBRAL AND PULMONARY EDEMA. DEATH IS POSSIBLE FROM RESPIRATORY FAILURE OR CIRCULATORY COLLAPSE. THE USUAL FATAL DOSE IS 100-250 ML. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION MAY BE DELAYED. IRREVERSIBLE CENTRAL NERVOUS SYSTEM EFFECTS INCLUDING MOTOR DYSFUNCTION WITH RIGIDITY, SPASTICITY, AND HYPOKINESIS HAVE BEEN REPORTED.
CHRONIC EXPOSURE- REPEATED OR PROLONGED INGESTION MAY CAUSE VISUAL IMPAIRMENT AND POSSIBLY, BLINDNESS. LIVER, KIDNEY, AND BRAIN DAMAGE MAY OCCUR. EFFECTS ON THE NEWBORN HAVE BEEN REPORTED FOLLOWING PROLONGED EXPOSURE TO METHYL ALCOHOL BY PREGNANT RATS.

FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. ALSO GIVE SODIUM BICARBONATE (BAKING SODA), 2 TEASPOONFULS IN WATER.

ANTIDOTE:
THE FOLLOWING ANTIDOTE(S) HAVE BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

METHANOL POISONING:
GIVE ETHANOL, 50% (100 PROOF), 1.5 ML/KG ORALLY INITIALLY, DILUTED TO NOT MORE THAN 5% SOLUTION, FOLLOWED BY 0.5-1.0 ML/KG EVERY 2 HOURS ORALLY OR INTRAVENOUSLY FOR 4 DAYS IN ORDER TO REDUCE METABOLISM OF METHANOL AND TO ALLOW TIME FOR ITS EXCRETION. BLOOD ETHANOL LEVEL SHOULD BE IN THE RANGE OF 1-1.5 MG/ML (DREISBACH, HANDBOOK OF POISONING, 11TH ED.) ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

ORAL OR INTRAVENOUS ADMINISTRATION OF 4-METHYLPYRAZOLE INHIBITS ALCOHOL DEHYDROGENASE AND HAS BEEN USED EFFECTIVELY AS AN ANTIDOTE FOR METHANOL OR ETHYLENE GLYCOL POISONING.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
METHYL ALCOHOL (METHANOL):
ACETYL BROMIDE: VIOLENT REACTION WITH FORMATION OF HYDROGEN BROMIDE.
ALKYLALUMINUM SOLUTIONS: VIOLENT REACTION.
ALUMINUM: EXPLOSION HAZARD.
BARIUM PERCHLORATE: DISTILLATION YIELDS HIGHLY EXPLOSIVE ALKYL PERCHLORATE.
BERYLLIUM HYDRIDE: VIOLENT REACTION, EVEN AT -196 C.
BROMINE: VIGOROUSLY EXOTHERMIC REACTION.
CALCIUM CARBIDE: VIOLENT REACTION.
CHLORINE: POSSIBLE IGNITION AND EXPLOSION HAZARD.
CHLOROFORM AND SODIUM HYDROXIDE: EXPLOSIVE REACTION.
CHROMIUM TRIOXIDE (CHROMIC ANHYDRIDE): POSSIBLE IGNITION.
CYANURIC CHLORIDE: VIOLENT REACTION.
DICHLOROMETHANE: POSSIBLE IGNITION AND EXPLOSION.
DIETHYL ZINC: POSSIBLE IGNITION AND EXPLOSION.
HYDROGEN PEROXIDE + WATER: EXPLOSION HAZARD.
IODINE + ETHANOL + MERCURIC OXIDE: EXPLOSION HAZARD.
LEAD: CORRODES.

LEAD PERCHLORATE: EXPLOSION HAZARD.
MAGNESIUM: VIOLENT REACTION.
MAGNESIUM (POWDERED): MIXTURES ARE CAPABLE OF DETONATION.
NICKEL: POSSIBLE IGNITION IN THE PRESENCE OF NICKEL CATALYST.
NITRIC ACID (CONCENTRATED): MIXTURES OF GREATER THAN 25% ACID MAY DECOMPOSE VIOLENTLY.
OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
PERCHLORIC ACID: EXPLOSION HAZARD.
PHOSPHOROUS TRIOXIDE: POSSIBLE VIOLENT REACTION AND IGNITION.
POTASSIUM: POSSIBLE DANGEROUS REACTION.
POTASSIUM HYDROXIDE + CHLOROFORM: EXOTHERMIC REACTION.
POTASSIUM TERT-BUTOXIDE: FIRE AND EXPLOSION HAZARD.
SODIUM + CHLOROFORM: POSSIBLE EXPLOSION.
SODIUM HYPOCHLORITE: EXPLOSION HAZARD.
SODIUM METHOXIDE + CHLOROFORM: POSSIBLE EXPLOSION.
SULFURIC ACID: FIRE AND EXPLOSION HAZARD.
ZINC: EXPLOSION HAZARD.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER U154.

==========

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION AND POISON HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

==========

SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

AIR SPILL:
APPLY WATER SPRAY TO KNOCK DOWN VAPORS.

WATER SPILL:
ALLOW SPILLED MATERIAL TO AERATE.

LIMIT SPILL MOTION AND DISPERSION WITH NATURAL BARRIERS OR OIL SPILL CONTROL BOOMS.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET THE PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

METHYL ALCOHOL (METHANOL):

2000 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

5000 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

10,000 PPM- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A TIGHT-FITTING FACEPIECE OPERATED IN A CONTINUOUS FLOW MODE.

25,000 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

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

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 09/25/84 REVISION DATE: 11/09/88

-ADDITIONAL INFORMATION-
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J. T. Baker Inc.

222 Red School Lane Phillipsburg, N.J. 08865
24-Hour Emergency Telephone -- (201) 859-2151

Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

MATERIAL SAFETY DATA SHEET

SECTION I - PRODUCT IDENTIFICATION

Product Name: **Methanol**
Formula: CH_3OH
Formula Wt: 32.04
CAS No.: 67-56-1
NIOSH/RTECS No.: PC1400000
Common Synonyms: Methyl Alcohol; Wood Alcohol, Carbinol; Methylol; Wood Spirit
Product Codes: 9074,9090,5936,9076,9049,9073,5217,9091,9075,P704,9071,9127 5370,9263,9070,9072,9069,9093,9068

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA™ System

Laboratory Protective Equipment

Precautionary Label Statements

POISON! DANGER!
FLAMMABLE
HARMFUL IF INHALED
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.

SECTION II - HAZARDOUS COMPONENTS

Component	%	CAS No.

Continued on Page: 2

J. T. Baker Inc.
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MATERIAL SAFETY DATA SHEET

SECTION II - HAZARDOUS COMPONENTS (Continued)

Methanol	90-100	67-56-1

SECTION III - PHYSICAL DATA

Boiling Point: 65°C (149°F) Vapor Pressure(mmHg): 96

Melting Point: -98°C (-144°F) Vapor Density(air=1): 1.11

Specific Gravity: 0.79 (H_2O=1) Evaporation Rate: 4.6 (Butyl Acetate=1)

Solubility(H_2O): Complete (in all proportions) % Volatiles by Volume: 100

Appearance & Odor: Clear, colorless liquid with characteristic pungent odor.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Closed Cup): 12°C (54°F) NFPA 704M Rating: 1-3-0

Flammable Limits: Upper - 36.0 % Lower - 6.0 %

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 strong oxidizers may cause fire.
Burns with a clear, almost invisible flame.

Toxic Gases Produced

Carbon monoxide, carbon dioxide, formaldehyde

SECTION V - HEALTH HAZARD DATA

TLV listed denotes (TLV-skin).

Threshold Limit Value (TLV/TWA): 260 mg/m^3 (200 ppm)

Short-Term Exposure Limit (STEL): 310 mg/m^3 (250 ppm)

Continued on Page: 3

SECTION V - HEALTH HAZARD DATA (Continued)

Permissible Exposure Limit (PEL): 260 mg/m^3 (200 ppm)

Toxicity:	LD_{50} (oral-rat)(mg/kg)	-	5628
	LD_{50} (ipr-rat)(mg/kg)	-	3540
	LD_{50} (scu-mouse)(mg/kg)	-	3300
	LD_{50} (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, suffocation, 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, gastrointestinal irritation, central nervous system depression and hearing loss.
Chronic effects of overexposure may include kidney and/or liver damage.

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.

SECTION VI - REACTIVITY DATA

Stability: Stable Hazardous Polymerization: Will not occur

Conditions to Avoid: heat, flame, other sources of ignition

Incompatibles: strong oxidizing agents, strong acids, zinc, aluminum, magnesium

Continued on Page: 4

SECTION VI - REACTIVITY DATA (Continued)

Decomposition Products: carbon monoxide, carbon dioxide, formaldehyde

SECTION VII - 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. 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 with sand or other non-combustible absorbent material and place into container for later disposal. Flush area with water.

J. T. Baker Solusorb® 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)

SECTION VIII - INDUSTRIAL 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.

SECTION IX - 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.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

Proper Shipping Name: Methyl alcohol
Hazard Class: Flammable liquid

Continued on Page: 5

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION (Continued)

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

N/A - Not Applicable or Not Available

The information published in this Material Safety Data Sheet has been compiled from our experience and data presented in various technical publications. It is the user's responsibility to determine the suitability of this information for the adoption of necessary safety precautions. We reserve the right to revise Material Safety Data Sheets periodically as new information becomes available. J. T. Baker makes no warranty or representation about the accuracy or completeness nor fitness for purpose of the information contained herein.

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12/14/85

MATERIAL SAFETY DATA SHEET 2.968

SECTION I - NAME AND PRODUCT

MFG NAME AND ADDRESS
EM SCIENCES /MCB
P.O. BOX 5018

CHERRYHILL
NJ 080340395

CHEMICAL NUMBER: MMX0488-1
ITEM NUMBER : 400499
VNDR CATLG NBR :
ENTRY DATE : 08-22-85
CHANGE DATE :
EMERGENCY PHONE: 609 4236300

CHEMICAL NAME :
METHANOL OMNISOLV 1.0GL (4 LT)
TRADE NAME SYN :
METHYL ALCOHOL, WOOD ALCOHOL
CHEMICAL FAMILY :
ALCOHOLS

SECTION II - HAZARDOUS INGREDIENTS

HAZARDOUS COMPONENTS:
REFER TO SECTION 4-9

DOT - FLAMMABLE LIQUID

SECTION III - PHYSICAL DATA S/10 = SEE SECTION X

BOIL. POINT	SPECIFIC GRAVITY	VAPOR PRESS.	MELT. POINT	VAPOR DENSITY	EVAP. RATE	SOLUBLE IN WATER	PERCENT VOLATILE
64.5C	0.79	96	-144F	1.1	5.91 BUTYL ACETATE	SOLBLE	100

APPEARANCE AND ODOR:
COLORLESS LIQUID, SLIGHT ALCOHOLIC ODOR

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 52 DEG. F. (TCC)
FLAMMABLE LEL: 6.7%
FLAMMABLE UEL: 35%

EXTINGUISHING MEDIA:
CO2, DRY CHEMICAL, FOAM, WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.
WATER SPRAY TO DISPERSE VAPORS.

SPECIAL FIRE FIGHTING PROCEDURES:
WEAR SELF-CONTAINED BREATHING APPARATUS

UNUSUAL FIRE AND EXPLOSION HAZARDS:
ADDITION OF WATER TO BURNING FUEL MAY REDUCE INTENSITY OF FLAME.

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MATERIAL SAFETY DATA SHEET 2,968

SECTION V - HEALTH HAZARD DATA

THRESHOLD-LIMIT-VALUE:
OSHA STD-AIR: TWA 200 PPM TXDS: ORL-HMN LDLO: 340 MG/KG

EFFECTS OF OVEREXPOSURE:
HIGHLY TOXIC BY FUMES AND CONTACT; INGESTION MAY BE FATAL AND DAILY CONTACT WILL HAVE CUMLATIVE EFFECT. MAY CAUSE INEBRIATION, NAUSEA, VOMITING; CENTRAL NERVOUS SYSTEM DAMAGE; BLINDNESS; DEFATTING, DRYING AND CRACKING OF THE SKIN.

EMERGENCY AND FIRST AID PROCEDURES:
SKIN: WASH WITH SOAP/WATER; GET MEDICAL ASSISTANCE FOR SKIN IRRITATION.
EYES: FLUSH WITH WATER 15 MINUTES; GET MEDICAL ASSISTANCE.
INHALATION: REMOVE TO FRESH AIR; GET MEDICAL ASSISTANCE.
INGESTION: INDUCE VOMITING IF CONSCIOUS; GET MEDICAL ASSISTANCE.

SECTION VI - REACTIVITY DATA

INDICATORS: STABILITY - STABLE POLYMERIZATION - MAY NOT OCCUR

CONDITIONS TO AVOID:
HEAT, SPARKS, OPEN FLAME

INCOMPATIBILITY (MATL TO AVOID):
OXIDIZERS

HAZARDOUS DECOMPOSITION OR BY PRODUCTS:
COX

POLYMERIZATION CONTIONS TO AVOID:
N/A

SECTION VII - SPILL OR LEAK PROCEDURES OR DISPOSAL

MATERIAL RELEASE OR SPILL PROCEDURES:

EVACUATE NON-ESSENTIAL PERSONNEL. ABSORB WITH SAND.

WASTE DISPOSAL METHOD:

TO BE PERFORMED IN COMPLIANCE WITH ALL CURRENT LOCAL, STATE, AND FEDERAL REGULATIONS.

MATERIAL SAFETY DATA SHEET 2.968

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SECTION VIII- SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:
WEAR AIR-SUPPLIED MASK, DO NOT BREATHE VAPOR.
VENTILATION - LOCAL:
PROVIDE ADEQUATE GENERAL MECHANICAL AND LOCAL EXHAUST VENTILATION.
VENTILATION - MECHANICAL:
N/A
VENTILATION - SPECIAL:
N/A
OTHER
DO NOT GET IN EYES OR ON CLOTHING. FACE SHIELD MAY BE NECESSARY
PROTECTIVE GLOVES:
SAFETY GLOVES
EYE PROTECTION:
SAFETY GOGGLES

SECTION IX - SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:
KEEP CONTAINER TIGHTLY CLOSED. NO SMOKING OR FLARES. STORE IN A WELL-VENTILATED AREA, AWAY FROM SOURCES OF IGNITION. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. IF INGESTED, CAN CAUSE BLINDNESS; CANNOT BE MADE NON-POISONOUS.

SECTION X - OTHER INFORMATION

NFPA 704:	1	3	0
	HEALTH	FLAMMABILITY	REACTIVITY

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NOTE: NA OR N/A DENOTES NOT-AVAILABLE OR NON-APPLICABLE

[illegible] SHEET

[illegible] SCIENCE
A DIVISION OF [illegible]
[illegible]
[illegible]

PREPARATION DATE .....: OCT 27, 197

[illegible] NUMBER.:
([illegible]) [illegible]
[illegible]
1-[illegible]-[illegible]

| FDA HAZARD RATINGS

| HEALTH ....: 1 FLAMMABILITY ...: 3
| REACTIVITY : 0 SPECIAL HAZARDS.: N/A

SECTION I - GENERAL INFORMATION

CATALOG NUMBER(S): [illegible] [illegible] MX0484 MX0[illegible]5 MX04255
[illegible] [illegible] MX04[illegible] [illegible] MX14[illegible]

CHEMICAL NAME.....: METHANOL
TRADE NAME.....: METHYL ALCOHOL, WOOD ALCOHOL
CAS# NUMBER.....: 67-56-1
CHEMICAL FAMILY...: ALIPHATIC ALCOHOL
FORMULA.....: CH3OH
MOLECULAR WEIGHT..: 32.04
[illegible]: N/A
[illegible]: N/A

SECTION II - HAZARDOUS INGREDIENTS
[illegible] THAN 1% [illegible]

SECTION III - PHYSICAL DATA
BOILING POINT (C [illegible]): 64.6
MELTING POINT (C).....: -98
SPECIFIC GRAVITY ([illegible] = 1)....: [illegible]
VAPOR PRESSURE ([illegible]).....: [illegible]
PERCENT VOLATILE BY VOL (%)..: [illegible]
VAPOR DENSITY ([illegible])....: [illegible]
EVAPORATION RATE ([illegible])....: [illegible]
[illegible] SOLUBILITY IN WATER (%)....: [illegible]
[illegible] ....: [illegible] LIMITS
[illegible] CHARACTER [illegible]

SECTION IV - FIRE AND EXPLOSION HAZARD DATA
FLASH POINT (F).....: 52F (TCC)
FLAMMABLE LIMITS LEL %: 6.7
FLAMMABLE LIMITS UEL %: [illegible]
EXTINGUISHING MEDIA.....:
CO2, DRY CHEMICAL, "ALCOHOL" FOAM. [illegible] LIST
[illegible]-MX[illegible] PAGE # : 01

FIRE FIGHTING PROCEDURES.....:
WEAR SELF-CONTAINED BREATHING APPARATUS
FIRE & EXPLO. HAZARDS.....:
-CLOSED CONTAINERS MAY EXPLODE WHEN HEATED.

SECTION V - HEALTH HAZARD DATA (ACUTE AND CHRONIC)
ACGIH TLV/OSHA PEL (TWA).....:
& PEL: [illegible] (TWA) STEL: [illegible] (CEIL)
TOXICITY DATA.....:
-ORAL-RAT LD50: [illegible] MG/KG DERMAL-RAT LD50: [illegible] MG/KG
INHL-RAT LC50: [illegible]
SYMPTOMS OF EXPOSURE.....:
-TOXIC BY INGESTION, INHALATION.
AFFECTS CENTRAL NERVOUS SYSTEM, PARALYSIS, OPTIC NERVE
CAUSES DIZZINESS, NAUSEA, HEADACHE, BLURRED VISION, NARCOSIS,
[illegible]
POSSIBLE CANCER HAZARD
[illegible]
CAN BE TOXIC BY SKIN ABSORPTION
PROLONGED OR REPEATED SKIN CONTACT MAY CAUSE IRRITATION.
MEDICAL CONDITIONS AGGRAVATED BY EXP: DATA NOT AVAILABLE.
ROUTES OF ENTRY.....: INHALATION, INGESTION, SKIN CONTACT.
CARCINOGENICITY.....: [illegible] NO, SECTION V: IF NO INFORMATION [illegible] LISTED AS A CARCINOGENIC AGENT.
EMERGENCY FIRST AID.....:
GAS: BREAK VOLUNTARY OF EYE ALL CLOTHES OR UNDERGARMENTS
SKIN: WASH THOROUGHLY WITH SOAP AND WATER.
EYES: IF [illegible] IMMEDIATELY [illegible] OF WATER.
INHALATION: [illegible] IF NECESSARY, GIVE ARTIFICIAL RESPIRATION IF [illegible]
INGESTION: [illegible] LIGHT HEADED ATTENTION
[illegible]

SECTION VI - REACTIVITY DATA
STABILITY.....: YES
CONDITIONS TO AVOID.....:
-HEAT, [illegible]
INCOMPATIBLE MATERIALS.....: ( ) [illegible] ( ) [illegible]
( ) [illegible] ( ) [illegible] (X) [illegible]
(X) OTHER (SPECIFY)- OXIDIZING MATERIALS
HAZARDOUS POLYMERIZATION.....: DATA NOT AVAILABLE.
HAZARDOUS DECOMPOSITION.....: -CO, CO2, [illegible]

SECTION VII - SPECIAL PROTECTION PROCEDURES
SPILL RESPONSE:
-SMALL SPILL; TAKE UP WITH ABSORBENT; CONTAINERIZE FOR PROPER DISPOSAL
WASTE DISPOSAL: [illegible] IN ACCORDANCE WITH ALL CURRENT LOCAL, STATE AND FEDERAL REGULATIONS.

SECTION VIII - SPECIAL PROTECTION INFORMATION

VENTILATION, RESPIRATORY PROTECTION, PROTECTIVE CLOTHING, EYE PROTECTION:

- MATERIAL SHOULD BE HANDLED OR TRANSFERRED ONLY IN AN APPROVED FUME HOOD WITH ADEQUATE VENTILATION
- PROTECTIVE GLOVES (STEEL [illegible], VITON OR EQUIVALENT) SHOULD BE WORN [illegible]
- SAFETY GLASSES OR [illegible] SHOULD BE WORN AT ALL TIMES
- HIGH-APPROACH [illegible] TO BE USED IN THE ABSENCE OF ADEQUATE VENTILATION

SECTION IX - SPECIAL PRECAUTIONS INFORMATION

HANDLING & STORAGE ....:

- KEEP CONTAINER CLOSED
- STORE IN A COOL [illegible] WITH OXIDIZERS AND OXIDIZERS
- DO NOT BREATHE VAPORS
- DO NOT GET IN EYES
- AVOID PROLONGED OR REPEATED SKIN CONTACT
- DO NOT TAKE INTERNALLY
- ELECTRICALLY BOND ALL EQUIPMENT WHEN HANDLING THIS PRODUCT

WORK/HYGIENIC PRACTICES: WASH THOROUGHLY AFTER HANDLING. DO NOT TAKE INTERNALLY. [illegible] EQUIPMENT SHOULD BE READILY AVAILABLE.

SECTION X - OTHER INFORMATION

COMMENTS.....:

- [illegible] TO STATE OFFICIAL [illegible] NOTICE
- AVOID [illegible] AND [illegible] EFFECTS

REV. 8/97

N/A

REVISION [illegible].....: [illegible] N/A

N/A = NOT AVAILABLE:

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METHANOL
METHANOL
METHANOL

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-56-1

SUBSTANCE: **METHANOL**

TRADE NAMES/SYNONYMS:
METHYL ALCOHOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE; WOOD SPIRIT; WOOD NAPHTHA; METHYLOL; COLONIAL SPIRIT; COLUMBIAN SPIRIT; PYROXYLIC SPIRIT; COULOMATIC (R) CONDITIONER SOLUTION; STANDARD WATER IN METHANOL; STCC 4909230; UN 1230; RCRA U154; A454; A452; A936; A408; A947; A935; BP1105; A412; A411; A433P; SW2;; SC95; A452SK; A408SK; A412P; A434; A412SK; A450; A433S; CH40; ACC14280

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C-H3-O-H

MOLECULAR WEIGHT: 32.04

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: METHYL ALCOHOL (METHANOL) PERCENT: 100
CAS# 67-56-1

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
METHYL ALCOHOL (METHANOL):
200 PPM (262 MG/M3) OSHA TWA (SKIN); 250 PPM (328 MG/M3) OSHA STEL
200 PPM (262 MG/M3) ACGIH TWA (SKIN); 250 PPM (328 MG/M3) ACGIH STEL
200 PPM (262 MG/M3) NIOSH RECOMMENDED TWA (SKIN);
250 PPM (328 MG/M3) NIOSH RECOMMENDED STEL
200 PPM (262 MG/M3) DFG MAK TWA (SKIN);
400 PPM (524 MG/M3) DFG MAK 30 MINUTE PEAK, AVERAGE VALUE, 4 TIMES/SHIFT

MEASUREMENT METHOD: SILICA GEL TUBE; WATER; GAS CHROMATOGRAPHY WITH FLAME IONIZATION DETECTION; (NIOSH VOL. III # 2000, METHANOL).

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS LIQUID WITH A CHARACTERISTIC ALCOHOLIC ODOR.

BOILING POINT: 149 F (65 C) MELTING POINT: -137 F (-94 C)

SPECIFIC GRAVITY: 0.7914 VAPOR PRESSURE: 97.25 MMHG @ 20 C

EVAPORATION RATE: (BUTYL ACETATE=1) 4.6 SOLUBILITY IN WATER: VERY SOLUBLE

ODOR THRESHOLD: 100 PPM VAPOR DENSITY: 1.11

SOLVENT SOLUBILITY: ETHER, BENZENE, ALCOHOL, ACETONE, CHLOROFORM, ETHANOL.

VISCOSITY: 0.59 CPS @ 20 C

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT, FLAME, OR OXIDIZERS.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE

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OF IGNITION AND FLASH BACK..

VAPOR-AIR MIXTURES ARE EXPLOSIVE.

FLASH POINT: 52 F (11 C) (CC) UPPER EXPLOSIVE LIMIT: 36.0%

LOWER EXPLOSIVE LIMIT: 6.0% AUTOIGNITION TEMP.: 725 F (385 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL-RESISTANT FOAM (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL-RESISTANT FOAM (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. DIKE FIRE-CONTROL WATER FOR LATER DISPOSAL; DO NOT SCATTER THE MATERIAL. APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF TANK DUE TO FIRE. ISOLATE FOR 1/2 MILE IN ALL DIRECTIONS IF TANK, RAIL CAR OR TANK TRUCK IS INVOLVED IN FIRE (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 28).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG, SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND SUBPART E:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.119
EXCEPTIONS: 49 CFR 173.118

FINAL RULE ON HAZARDOUS MATERIALS REGULATIONS (HMR, 49 CFR PARTS 171-180), DOCKET NUMBERS HM-181, HM-181A, HM-181B, HM-181C, HM-181D AND HM-204. EFFECTIVE DATE OCTOBER 1, 1991. HOWEVER, COMPLIANCE WITH THE REGULATIONS IS AUTHORIZED ON AND AFTER JANUARY 1, 1991. (55 FR 52402, 12/21/90)

EXCEPT FOR EXPLOSIVES, INHALATION HAZARDS, AND INFECTIOUS SUBSTANCES, THE EFFECTIVE DATE FOR HAZARD COMMUNICATION REQUIREMENTS IS EXTENDED TO OCTOBER 1, 1993. (56 FR 47158, 10/18/91)

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
METHYL ALCOHOL-UN 1230

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

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

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
FLAMMABLE LIQUID, POISON

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS:
EXCEPTIONS: NONE
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.243

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 1 L
CARGO AIRCRAFT ONLY: 60 L

TOXICITY

METHYL ALCOHOL (METHANOL):
IRRITATION DATA: 20 MG/24 HOURS SKIN-RABBIT MODERATE; 40 MG EYE-RABBIT MODERATE; 100 MG/24 HOURS EYE-RABBIT MODERATE.
TOXICITY DATA: 86,000 MG/M3 INHALATION-HUMAN TCL0; 300 PPM INHALATION-HUMAN TCL0; 64,000 PPM/4 HOURS INHALATION-RAT LC50; 1000 PPM INHALATION-MONKEY LCL0; 50 GM/M3/2 HOURS INHALATION-MOUSE LCL0; 44,000 MG/M3/6 HOURS INHALATION-CAT LCL0; 15,800 MG/KG SKIN-RABBIT LD50; 393 MG/KG SKIN-MONKEY LDL0; 428 MG/KG ORAL-HUMAN LDL0; 143 MG/KG ORAL-HUMAN LDL0; 6422 MG/KG ORAL-MAN LDL0; 3429 MG/KG ORAL-MAN TDL0; 4 GM/KG ORAL-WOMAN TDL0; 7 GM/KG ORAL-MONKEY LD50; 5628 MG/KG ORAL-RAT LD50; 7300 MG/KG ORAL-MOUSE LD50; 14,200 MG/KG ORAL-RABBIT LD50; 7500 MG/KG ORAL-DOG LDL0; 9800 MG/KG SUBCUTANEOUS-MOUSE LD50; 2131 MG/KG INTRAVENOUS-RAT LD50; 4710 MG/KG

INTRAVENOUS-MOUSE LD50; 8907 MG/KG INTRAVENOUS-RABBIT LD50; 4641 MG/KG INTRAVENOUS-CAT LDLO; 7529 MG/KG INTRAPERITONEAL-RAT LD50; 10,765 MG/KG INTRAPERITONEAL-MOUSE LD50; 1826 MG/KG INTRAPERITONEAL-RABBIT LD50; 3556 MG/KG INTRAPERITONEAL-GUINEA PIG LD50; 8555 MG/KG INTRAPERITONEAL-HAMSTER LD50; 868 MG/KG UNREPORTED-MAN LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: IRRITANT- SKIN, EYE.
ACUTE TOXICITY LEVEL: SLIGHTLY TOXIC BY INHALATION, DERMAL ABSORPTION, INGESTION.
TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT; NEUROTOXIN.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH KIDNEY, EYE OR SKIN DISORDERS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
METHYL ALCOHOL (METHANOL):
NARCOTIC/NEUROTOXIN. 25,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- MAY CAUSE IRRITATION OF THE MUCOUS MEMBRANES, COUGHING, OPPRESSION IN THE CHEST, TRACHEITIS, BRONCHITIS, TINNITUS, UNSTEADY GAIT, TWITCHING, COLIC, CONSTIPATION, NYSTAGMUS, AND BLEPHAROSPASM. SYMPTOMS FROM OCCUPATIONAL EXPOSURE INCLUDE PARESTHESIAS, NUMBNESS AND SHOOTING PAINS IN THE HANDS AND FOREARMS. METABOLIC ACIDOSIS, AND EFFECTS ON THE EYES AND CENTRAL NERVOUS SYSTEM MAY OCCUR AS DETAILED IN ACUTE INGESTION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE EFFECTS AS IN ACUTE INGESTION. REPEATED EXPOSURE TO 200-375 PPM CAUSED RECURRENT HEADACHES IN WORKERS. EXPOSURE FOR 4 YEARS TO 1200-8000 PPM RESULTED IN MARKED DIMINUTION OF VISION AND ENLARGEMENT OF THE LIVER IN A WORKMAN. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
METHYL ALCOHOL (METHANOL):
IRRITANT/NARCOTIC/NEUROTOXIN.
ACUTE EXPOSURE- CONTACT WITH LIQUID MAY CAUSE IRRITATION. SKIN ABSORPTION MAY OCCUR AND CAUSE METABOLIC ACIDOSIS AND EFFECTS ON THE EYES AND CENTRAL NERVOUS SYSTEM AS DETAILED IN ACUTE INGESTION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH THE LIQUID MAY CAUSE DEFATTING OF THE SKIN RESULTING IN ERYTHEMA, SCALING, AND ECZEMATOID DERMATITIS. CHRONIC ABSORPTION MAY RESULT METABOLIC ACIDOSIS AND EFFECTS AS DETAILED IN ACUTE INGESTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
METHYL ALCOHOL (METHANOL):
IRRITANT.
ACUTE EXPOSURE- VAPORS MAY CAUSE IRRITATION. HIGH CONCENTRATIONS HAVE BEEN REPORTED TO CAUSE VIOLENT INFLAMMATION OF THE CONJUNCTIVA AND EPITHELIAL DEFECTS ON THE CORNEA. MILD IRRITATION MAY OCCUR WITH DILUTE SOLUTIONS; THE UNDILUTED LIQUID HAS PRODUCED MODERATE CORNEAL OPACITY AND CONJUNCTIVAL REDNESS IN RABBITS. APPLICATION OF A DROP OF METHANOL IN RABBIT EYES CAUSED A MILD REVERSIBLE REACTION, GRADED 3 ON A SCALE OF 1-10 AFTER 24 HOURS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
METHYL ALCOHOL (METHANOL):
NARCOTIC/NEUROTOXIN.
ACUTE EXPOSURE- MAY CAUSE MILD AND TRANSIENT INEBRIATION AND SUBSEQUENT DROWSINESS FOLLOWED BY AN ASYMPTOMATIC PERIOD LASTING 8-48 HOURS. FOLLOWING THE DELAY, COUGHING, DYSPNEA, HEADACHE, DULLNESS, WEAKNESS, VERTIGO OR DIZZINESS, NAUSEA, VOMITING, OCCASIONAL DIARRHEA, ANOREXIA, VIOLENT PAIN IN THE BACK, ABDOMEN, AND EXTREMITIES, RESTLESSNESS, APATHY OR DELIRIUM, AND RARELY, EXCITEMENT AND MANIA MAY OCCUR. RAPID, SHALLOW RESPIRATION DUE TO METABOLIC ACIDOSIS, COLD AND CLAMMY SKIN, HYPOTENSION, CYANOSIS, OPISTHOTONOS, CONVULSIONS, MILD TACHYCARDIA, CARDIAC DEPRESSION, PERIPHERAL NEURITIS, CEREBRAL AND PULMONARY EDEMA, UNCONSCIOUSNESS, AND COMA ARE POSSIBLE. EFFECTS ON THE EYE MAY INCLUDE OPTIC NEURITIS, BLURRED OR DIMMED VISION, DILATED, UNRESPONSIVE PUPILS, PTOSIS, EYE PAIN, CONCENTRIC CONSTRICTION OF VISUAL FIELDS, DIPLOPIA, CHANGE IN COLOR PERCEPTION, PHOTOPHOBIA, AND OPTIC NERVE ATROPHY. PARTIAL BLINDNESS OR POSSIBLY DELAYED TRANSIENT OR PERMANENT BLINDNESS MAY OCCUR. BILATERAL SENSORINEURAL DEAFNESS HAS BEEN REPORTED IN A SINGLE CASE. LIVER, KIDNEY, HEART, STOMACH, INTESTINAL AND PANCREATIC DAMAGE MAY ALSO OCCUR. DEATH MAY BE DUE TO RESPIRATORY FAILURE OR RARELY FROM CIRCULATORY COLLAPSE. AS LITTLE AS 15 ML HAS CAUSED BLINDNESS; THE USUAL FATAL DOSE IS

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60-240 ML. PROLONGED ASTHENIA AND IRREVERSIBLE EFFECTS ON THE NERVOUS SYSTEM INCLUDING DIFFICULTY IN SPEECH, MOTOR DYSFUNCTION WITH RIGIDITY, SPASTICITY, AND HYPOKINESIS HAVE BEEN REPORTED.
CHRONIC EXPOSURE- REPEATED INGESTION MAY CAUSE VISUAL IMPAIRMENT AND BLINDNESS AND OTHER SYSTEMIC EFFECTS AS DETAILED IN ACUTE INGESTION. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- IF INGESTION OF METHANOL IS DISCOVERED WITHIN 2 HOURS, GIVE SYRUP OF IPECAC. LAVAGE THOROUGHLY WITH 2-4 L OF TAP WATER WITH SODIUM BICARBONATE (20 G/L) ADDED. GET MEDICAL ATTENTION IMMEDIATELY. LAVAGE SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL (DREISBACH, HANDBOOK OF POISONING, 12TH ED.).

ANTIDOTE:
THE FOLLOWING ANTIDOTE(S) HAVE BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

METHANOL POISONING:
GIVE ETHANOL, 50% (100 PROOF), 1.5 ML/KG ORALLY INITIALLY, DILUTED TO NOT MORE THAN 5% SOLUTION, FOLLOWED BY 0.5-1.0 ML/KG EVERY 2 HOURS ORALLY OR INTRAVENOUSLY FOR 4 DAYS IN ORDER TO REDUCE METABOLISM OF METHANOL AND TO ALLOW TIME FOR ITS EXCRETION. BLOOD ETHANOL LEVEL SHOULD BE IN THE RANGE OF 1-1.5 MG/ML (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

ORAL OR INTRAVENOUS ADMINISTRATION OF 4-METHYLPYRAZOLE INHIBITS ALCOHOL DEHYDROGENASE AND HAS BEEN USED EFFECTIVELY AS AN ANTIDOTE FOR METHANOL OR ETHYLENE GLYCOL POISONING (ELLENHORN AND BARCELOUX, MEDICAL TOXICOLOGY).

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
METHYL ALCOHOL (METHANOL):
- ACETYL BROMIDE: VIOLENT REACTION WITH FORMATION OF HYDROGEN BROMIDE.
- ALKYLALUMINUM SOLUTIONS: VIOLENT REACTION.
- ALUMINUM: CORRODES.
- BARIUM PERCHLORATE: DISTILLATION YIELDS HIGHLY EXPLOSIVE ALKYL PERCHLORATE.
- BERYLLIUM HYDRIDE: VIOLENT REACTION, EVEN AT -196 C.
- BROMINE: VIGOROUSLY EXOTHERMIC REACTION.
- CALCIUM CARBIDE: VIOLENT REACTION.
- CHLORINE: POSSIBLE IGNITION AND EXPLOSION HAZARD.
- CHLOROFORM AND SODIUM HYDROXIDE: EXPLOSIVE REACTION.
- CHROMIUM TRIOXIDE (CHROMIC ANHYDRIDE): POSSIBLE IGNITION.
- CYANURIC CHLORIDE: VIOLENT REACTION.
- DICHLOROMETHANE: POSSIBLE IGNITION AND EXPLOSION.
- DIETHYL ZINC: POSSIBLE IGNITION AND EXPLOSION.
- HYDROGEN PEROXIDE + WATER: EXPLOSION HAZARD.
- IODINE + ETHANOL + MERCURIC OXIDE: EXPLOSION HAZARD.
- LEAD: CORRODES.
- LEAD PERCHLORATE: EXPLOSION HAZARD.
- MAGNESIUM: VIOLENT REACTION.
- MAGNESIUM (POWDERED): MIXTURES ARE CAPABLE OF DETONATION.
- METALS: INCOMPATIBLE.
- NICKEL: POSSIBLE IGNITION IN THE PRESENCE OF NICKEL CATALYST.
- NITRIC ACID (CONCENTRATED): MIXTURES OF GREATER THAN 25% ACID MAY DECOMPOSE VIOLENTLY.
- OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
- PERCHLORIC ACID: EXPLOSION HAZARD.
- PHOSPHOROUS TRIOXIDE: POSSIBLE VIOLENT REACTION AND IGNITION.
- PLASTICS, RUBBER, COATINGS: MAY BE ATTACKED.
- POTASSIUM: POSSIBLE DANGEROUS REACTION.
- POTASSIUM HYDROXIDE + CHLOROFORM: EXOTHERMIC REACTION.
- POTASSIUM TERT-BUTOXIDE: FIRE AND EXPLOSION HAZARD.
- SODIUM + CHLOROFORM: POSSIBLE EXPLOSION.
- SODIUM HYPOCHLORITE: EXPLOSION HAZARD.
- SODIUM METHOXIDE + CHLOROFORM: VIOLENT REACTION.
- SULFURIC ACID: FIRE AND EXPLOSION HAZARD.
- ZINC: EXPLOSION HAZARD.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

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STORAGE

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER U154.

****

CONDITIONS TO AVOID

AVOID CONTACT WITH HEAT, SPARKS, FLAMES OR OTHER IGNITION SOURCES. VAPORS MAY BE EXPLOSIVE. MATERIAL IS POISONOUS; AVOID INHALATION OF VAPORS OR CONTACT WITH SKIN. DO NOT ALLOW MATERIAL TO CONTAMINATE WATER SOURCES.

****

SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

AIR SPILL:
APPLY WATER SPRAY TO KNOCK DOWN VAPORS.

WATER SPILL:
ALLOW SPILLED MATERIAL TO AERATE.

LIMIT SPILL MOTION AND DISPERSION WITH NATURAL BARRIERS OR OIL SPILL CONTROL BOOMS.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

METHYL ALCOHOL (METHANOL):

2000 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

5000 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.

10,000 PPM- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR THAT HAS A TIGHT-FITTING FACEPIECE AND IS OPERATED IN A CONTINUOUS-FLOW MODE.

25,000 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY APPROPRIATE ESCAPE-TYPE, SELF-CONTAINED BREATHING APPARATUS.

DATE: 01/23/92 ACCT: 878660-01
INDEX: 01913530157 CAT NO: A4124 PO NBR: N/A

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

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC, INC.
CREATION DATE: 09/25/84 REVISION DATE: 11/06/91

-ADDITIONAL INFORMATION-

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MATERIAL SAFETY DATA SHEET

I. PRODUCT IDENTIFICATION

TRADE NAME: Methanol (as used in Protein Assay Kits I and II and Dye Reagent Concentrate)

Catalog No.: 500-0001, 500-0002, 500-0006
Chemical Identity, Common names: Methanol; Methyl alcohol; Carbinol; Wood alcohol; Wood naphtha, Methyl hydroxide.
Formula: CH_3OH **M.W.:** 32.04

MANUFACTURER'S NAME:
BIO-RAD LABORATORIES
3300 REGATTA BLVD.
RICHMOND, CALIFORNIA 94804

EMERGENCY PHONE No:
510/232-7000

DATE PREPARED OR REVISED:
June 5, 1990

NAME OF PREPARER: Roy Wood

II. HAZARDOUS INGREDIENTS

This product contains the following toxic chemical subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40 CFR 372:

CHEMICAL NAMES	CAS NUMBERS	PERCENT*	EXPOSURE LIMITS IN AIR		
			ACGIH TLV	OSHA PEL	OTHER
Methanol	67-56-1	25%	200 ppm (TWA)	200 ppm (TWA)	ACGIH TLV 250 ppm (STEL)

LD50:5628 mg/kg oral-rat (RTECS)
TWA = 8-hour Time Weighted Average
STEL = Short Term Exposure Limit (15 minute)
*The other 75% of the mix is 25% water and 50% phosphoric acid [see MSDS #500-0001(b)].

III. PHYSICAL/CHEMICAL CHARACTERISTICS

BOILING POINT: 64.5° C (148° F)
VAPOR PRESSURE: 97 mm Hg at 20° C
EVAPORATION RATE (BUTYL ACETATE = 1): 5.9
SOLUBILITY IN WATER: Complete
APPEARANCE AND COLOR: Clear liquid, alcohol odor.

SPECIFIC GRAVITY(H_2O = 1): 0.79
MELTING POINT: -98° C(-144° F)
VAPOR DENSITY(AIR = 1): 1.1

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 101° F (for a 25% solution)
(METHOD USED): Closed Cup

FLAMMABLE LIMITS: LEL=6%
UEL=36%

EXTINGUISHING MEDIA: Alcohol foam, carbon dioxide, dry chemical or water fog.
SPECIAL FIRE FIGHTING PROCEDURES: Fire fighters should wear full protective clothing and self-contained breathing apparatus with full facepiece. Use water to keep fire-exposed containers cool.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapor is heavier than air and may travel along the ground. Never use a welding or cutting torch near container (even empty). This material may burn with a flame which is invisible in daylight.

V. HEALTH HAZARD INFORMATION

SYMPTOMS OF OVEREXPOSURE (for each potential route of exposure):
INHALED: Excessive inhalation can cause nasal and respiratory irritation, visual disturbance, blurred vision, dizziness, giddiness, weakness, fatigue, nausea, vomiting, headache, possible unconsciousness, and asphyxiation.
CONTACT WITH SKIN OR EYES: Can cause irritation, tearing, blurred vision, drying of skin, and dermatitis.
ABSORBED THROUGH SKIN: May be absorbed through intact skin and produce systemic effects.
SWALLOWED: Can cause gastrointestinal irritation, headache, nausea, vomiting, blindness, unconsciousness, and death.

HEALTH EFFECTS OR RISKS FROM EXPOSURE
ACUTE: Poison! Swallowing or breathing high concentrations of methanol may produce headache, vomiting, nausea, irritation, dizziness, weakness, fatigue, giddiness, blurred vision, unconsciousness, blindness, and death. Methanol is extremely corrosive to the eyes.

Brief eye contact with the liquid or mist will severely damage the eyes and prolonged eye contact can cause permanent eye injury which may be followed by blindness.
Skin contact may irritate the skin, causing dermatitis. Methanol may be absorbed through intact skin, causing systemic effects.
CHRONIC: Marked impairment of vision, central nervous system damage, and death have been reported after prolonged or repeated exposure. Methyl alcohol may cause liver damage.

FIRST AID: EMERGENCY PROCEDURES
EYE CONTACT: Flush with large amounts of water for at least 15 minutes, lifting upper and lower lids occasionally. Get medical attention.
SKIN CONTACT: Flush skin with large amounts of water for at least 15 minutes, while removing contaminated clothing and shoes. Wash clothes before reuse. Get medical attention.
INHALED: Remove victim to fresh air. If breathing has stopped, give artificial respiration. Keep person warm. Get medical attention.
SWALLOWED: If conscious, immediately induce vomiting by giving two glasses of water and sticking a finger down the throat. After vomiting, give milk or water. Never give anything by mouth to an unconscious or convulsing person. Get medical attention immediately.

SUSPECTED CANCER AGENT
__X__NO: THIS PRODUCT'S INGREDIENTS ARE NOT FOUND IN THE LISTS BELOW.
YES: _____FEDERAL OSHA _____NTP _____IARC

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Those individuals with diseases of the eyes, liver, kidneys, and skin may be at increased risk from exposure.

VI. REACTIVITY DATA

STABLE____X__ **UNSTABLE**_____
CONDITIONS TO AVOID: Heat, sparks, and open flame.
INCOMPATIBILITY(Materials to avoid): Strong oxidizing agents, many metals, certain plastics, chloroform.
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon oxides and formaldehyde may form when heated to decomposition.
HAZARDOUS POLYMERIZATION MAY OCCUR_____ WILL NOT OCCUR__X__
CONDITIONS TO AVOID: Heat, sparks, and open flame.

VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL RESPONSE PROCEDURES: Dike and cover spill with noncombustible absorbent. Wear protective clothing including rubber apron, rubber gloves, rubber boots, chemical goggles ,and face shield. Wear an appropriate NIOSH-approved respirator. Eliminate all ignition sources.
PREPARING WASTES FOR DISPOSAL: Comply with all applicable federal, state, and local regulations on spill reporting, waste handling, and waste disposal.

VIII. SPECIAL HANDLING INFORMATION

VENTILATION AND ENGINEERING CONTROLS: Provide sufficient mechanical explosion proof ventilation to maintain exposure below exposure limits.
RESPIRATORY CONTROLS: Wear a NIOSH-approved respirator appropriate for the vapor concentration at the point of use. Appropriate respirators may be a supplied-air respirator or a self-contained breathing apparatus.
EYE PROTECTION: Chemical splash goggles or face shield.
GLOVES: Wear resistant gloves such as neoprene.
OTHER CLOTHING AND EQUIPMENT: Impervious clothing and boots.
WORK PRACTICES, HYGIENIC PRACTICES: Use good laboratory practices. Wash hands after using and before eating. Do not eat, drink, or smoke in the work area. Keep away from heat, sparks, and flames.
OTHER HANDLING AND STORAGE REQUIREMENTS: Store in closed containers. All handling equipment should be electrically grounded. Store in a cool, dry, well-ventilated place away from incompatible materials. Store in a flammable liquid storage area or cabinet. An eye wash and safety shower should be nearby and ready for use.
PROTECTIVE MEASURES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Protective clothing and appropriate respiratory protection should be worn. Do not cut, grind, weld, or drill on or near containers. Electrically ground all equipment and use only non-sparking tools.

We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and conditions of use of the product are not within the control of Bio-Rad, it is the user's responsibility to handle the product under conditions of safe use.

NITRIC ACID, 70%

Material Safety Data Sheet

Mallinckrodt Inc.
Science Products Division
P.O. Box M
Paris, Kentucky 40361

Emergency Telephone Number
314-982-5000

Effective Date: 08-21-85

PRODUCT IDENTIFICATION:

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 70%

Formula CAS No.: 7697-37-2 Molecular Weight: 63.00

Hazardous Ingredients: Chemical Formula: HNO_3
Not Applicable

PRECAUTIONARY MEASURES

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CAUSES SEVERE BURNS. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED.

Do not get in eyes, on skin, or on clothing.
Avoid breathing mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep from contact with clothing and other combustible materials.
Do not store near combustible materials.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Oxidizer

Physical Data SECTION 1

Appearance:
Clear, colorless to slightly yellow liquid.

Odor:
Suffocating acrid.

Solubility: Infinite in water.

Boiling Point: 122°C (252°F) Vapor Density (Air=1): 2-3 approximately

Melting Point: -34°C (-29°F) Vapor Pressure (mm Hg): 62 @ 20°C (68°F)

Specific Gravity: 1.41 Evaporation Rate: No information found.

Fire and Explosion Information SECTION 2

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.

Explosion:
Reacts explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc.

Fire Extinguishing Media: If involved in a fire, use water spray.

Special Information: Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Reactivity Data SECTION 3

Stability: Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products:
When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate. Will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization: Will not occur.

Incompatibilities:
A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.

Leak/Spill Disposal Information SECTION 4

Isolate or enclose the area of the leak or spill. Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic or corrosive fluids or vapors.

Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). Sewer with excess water.

Larger spills and lot sizes:
Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite) and dispose in a RCRA-approved waste facility or sewer the neutralized slurry with excess water if local ordinances allow. Provide forced ventilation to dissipate fumes.

Reportable Quantity (RQ)(CWA/CERCLA) : 1000 lbs.

Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.

Ingestion: Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.

Skin Contact: Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.

Eye Contact: Corrosive! Vapors are irritating and may cause damage to the eyes. Splashes may cause severe burns and permanent eye damage.

Chronic Exposure: Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

B. FIRST AID

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion: DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1982)

Inhalation (Rat) LC50: 244 ppm (NO_2)/30M

Occupational Control Measures — SECTION 6

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
2 ppm (TWA)
-ACGIH Threshold Limit Value (TLV):
2 ppm (TWA); 4ppm (STEL)

Ventilation System: A system of local exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the dust or vapor at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Pesonal Respirators: (NIOSH Approved) If the TLV is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or self-contained breathing apparatus.
Nitric acid is an oxidizer and should not come in contact with cartridges and canisters that contain oxidizable materials, such as activated charcoal.

Skin Protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible.Contact lenses should not be worn when working with this material.

Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information — SECTION 7

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight.
Isolate from incompatible substances. Protect from moisture.

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NITRIC ACID SOLUTIONS
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NITRIC ACID SOLUTIONS

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY CONTACTS
GASTON L. PILLORI
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CAT NO: SA941

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7697-37-2

SUBSTANCE: NITRIC ACID SOLUTIONS

TRADE NAMES/SYNONYMS:
NITRIC ACID, 4%; NITRIC ACID, 0.4%; SO-A-94; SO-A-95; ACC40072

CHEMICAL FAMILY:
INORGANIC ACID

MOLECULAR FORMULA: H-N-O3 MOL WT 63.02

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: NITRIC ACID PERCENT: 0.4-4.0

COMPONENT: WATER PERCENT: 96.0-99.6

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NITRIC ACID:
2 PPM (5 MG/M3) OSHA TWA
2 PPM ACGIH TWA; 4 PPM ACGIH STEL
2 PPM NIOSH RECOMMENDED 10 HOUR TWA

1000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
1000 POUNDS SARA SECTION 304 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID BOILING POINT: 212 F (100 C)

MELTING POINT: 32 F (0 C) SPECIFIC GRAVITY: 1.0

VAPOR PRESSURE: 14 MMHG @ 20 C EVAPORATION RATE: (ETHER = 1) >1

PH: ACIDIC SOLUBILITY IN WATER: SOLUBLE VAPOR DENSITY: 0.7 (WATER)

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 60).

EXTINGUISH USING AGENTS INDICATED; DO NOT USE WATER DIRECTLY ON MATERIAL. IF LARGE AMOUNTS OF COMBUSTIBLE MATERIALS ARE INVOLVED, USE WATER SPRAY OR FOG IN FLOODING AMOUNTS. USE WATER SPRAY TO ABSORB CORROSIVE VAPORS. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS; KEEP UPWIND.

TOXICITY

NITRIC ACID, FUMING:
67 PPM(NO_2)/4 HOURS INHALATION-RAT LC50; CARCINOGEN STATUS: NONE.
NITRIC ACID, FUMING IS TOXIC AND IS A SEVERE SKIN, EYE AND MUCOUS MEMBRANE IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NITRIC ACID, FUMING:
CORROSIVE/TOXIC. 100 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- MAY CAUSE COUGHING, HEADACHE, DIZZINESS, AND WEAKNESS. DELAYED SYMPTOMS MAY INCLUDE DRYNESS OF THE THROAT AND NOSE, CHEST PAIN OR TIGHTNESS, DYSPNEA, FROTHY SPUTUM, HYPOTENSTION AND CYANOSIS FOLLOWED BY PNEUMONITIS AND PULMONARY EDEMA, WHICH MAY BE FATAL. IF PATIENT RECOVERS, SCAR TISSUE MAY CAUSE STRICTURE OF THE PYLORUS OR ESOPHAGUS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DENTAL EROSION FOLLOWED BY JAW NECROSIS, CHRONIC COUGH AND BRONCHITIS OR CHEMICAL

PNEUMONITIS AND GASTROINTESTINAL DISTURBANCES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
NITRIC ACID, FUMING:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID OR CONCENTRATED VAPOR CAUSES IMMEDIATE SEVERE AND PENETRATING BURNS, STAINING THE SKIN YELLOW OR YELLOWISH-BROWN. DILUTE SOLUTIONS PRODUCE MILD IRRITATION AND HARDEN THE SKIN WITHOUT DESTROYING IT.
CHRONIC EXPOSURE- DEPENDING ON CONCENTRATION AND DURATION OF EXPOSURE, REPEATED OR PROLONGED EXPOSURE MAY CAUSE SYMPTOMS AS THOSE OF ACUTE EXPOSURE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING, BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
NITRIC ACID, FUMING:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT WITH THE LIQUID MAY CAUSE PAIN, PHOTOPHOBIA, TEARING, EDEMA, CORNEAL ULCERATION, SEVERE BURNS, AND NECROSIS OF THE DEEPER TISSUES WITH PERMANENT DAMAGE.
CHRONIC EXPOSURE- DEPENDING ON CONCENTRATION AND DURATION OF CONTACT, REPEATED OR PROLONGED EXPOSURE MAY CAUSE SYMPTOMS AS THOSE OF ACUTE EXPOSURE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NITRIC ACID, FUMING:
CORROSIVE.
ACUTE EXPOSURE- IMMEDIATE PAIN IN THE MOUTH, THROAT, AND STOMACH MAY BE FOLLOWED BY NAUSEA, VOMITING, DIARRHEA, HEMATEMESIS, HEMOPTYSIS, HYPOTENSION, NEPHRITIS, ALBUMINURIA, OLIGURIA, ANURIA, HEMATURIA, AND POSSIBLY CIRCULATORY COLLAPSE. ASPHYXIA IS POSSIBLE. BURNS OF THE GASTROINTESTINAL TRACT MAY BE SEVERE ENOUGH TO CAUSE PERFORATION OF THE ESOPHAGUS AND STOMACH WHICH MAY BE FOLLOWED BY MEDIASTINITIS OR PERITONITIS, INDICATED BY FEVER.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- IF VICTIM IS CONSCIOUS, GIVE HIM LARGE QUANTITIES OF WATER IMMEDIATELY TO DILUTE THE ACID. DO NOT INDUCE VOMITING. GIVE PATIENT 1 OUNCE (30 ML) OF MILK OF MAGNESIA. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
REACTS EXOTHERMICALLY WITH WATER.

INCOMPATIBILITIES:
NITRIC ACID:
ACETIC ACID: EXPLOSIVE REACTION IF NOT KEPT COLD.
ACETIC ACID AND ACETONE: EXPLOSIVE REACTION.
ACETIC ANHYDRIDE: EXPLOSIVE REACTION IF NOT KEPT COLD.
ACETONE AND SULFURIC ACID: VIOLENT DECOMPOSITION.
ACETONITRILE: EXPLOSIVE REACTION.
ACETYLENE: YIELDS TRINITROMETHANE, WHICH MELTS AT 15 C; LIQUID IS EXPLOSIVE.
ACROLEIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ACRYLONITRILE: EXPLOSIVE REACTION AT 90 C.
ALLYL ALCOHOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ALLYL CHLORIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
2-AMINOETHANOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
2-AMINOTHIAZOLE AND SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
AMMONIA (GAS): BURNS IN AN ATMOSPHERE OF NITRIC ACID VAPOR.
AMMONIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ANILINE: IGNITES SPONTANEOUSLY.
ANION EXCHANGE RESINS: POSSIBLE VIOLENT EXOTHERMIC REACTION.
ANTIMONY: VIOLENT REACTION.
AROMATIC AMINES: POSSIBLE IGNITION REACTION.
ARSINE: EXPLOSIVE REACTION.
BENZENE: EXPLOSIVE REACTION.
BENZOTHIOPHENE DERIVATIVES: FORMATION OF POSSIBLY EXPLOSIVE COMPOUNDS.
BISMUTH (POWDERED): INTENSE EXOTHERMIC REACTION.
BORON: VIOLENT REACTION WITH INCANDESCENCE.
BORON DECAHYDRATE: EXPLOSIVE REACTION.
BORON PHOSPHIDE: IGNITION REACTION WITH POSSIBLE DEFLAGRATION.
BROMINE PENTAFLUORIDE: IGNITION REACTION.
BUTANE THIOL: VIOLENT DECOMPOSITION.
N-BUTYL MERCAPTAN: IGNITION REACTION.
N-BUTYRALDEHYDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CALCIUM HYPOPHOSPHITE: IGNITION REACTION.
CARBON (PULVERIZED): VIOLENT REACTION.
CELLULOSE: FORMS EASILY COMBUSTIBLE ETHER.
CESIUM CARBIDE: EXPLOSIVE REACTION.
CHLORINE: INCOMPATIBLE.
4-CHLORO-2-NITROANILINE: FORMS EXPLOSIVE COMPOUND.
CHLOROSULFONIC ACID: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CROTONALDEHYDE: VIOLENT DECOMPOSITION WITH IGNITION.
CRESOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CUMENE: TEMPERATURE AND PRESSURE INCREASED IN CLOSED CONTAINER.
CUPRIC NITRIDE: EXPLOSIVE REACTION.
CUPROUS NITRIDE: VIOLENT REACTION.
CYANATES: POSSIBLE EXPLOSIVE REACTION.
CYCLIC KETONES: VIOLENT REACTION.
CYCLOHEXYLAMINE: FORMS EXPLOSIVE SOLUTION.
CYCLOHEXANOL: VIOLENT REACTION.
CYCLOHEXANONE: VIOLENT REACTION.
CYCLOPENTADIENE: EXPLOSIVE REACTION.

1,2-DIAMINOETHANE BISTRIMETHYL GOLD: EXPLOSIVE REACTION.
DIBORANE: SPONTANEOUS IGNITION.
DICHLOROMETHANE: FORMS EXPLOSIVE SOLUTION.
DIENE OR ACETYLENE DERIVATIVES: POSSIBLE IGNITION REACTION.
DIETHYL ETHER: INTENSE REACTION.
DIISOPROPYL ETHER: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
DINITROTOLUENE: EXPLOSIVE REACTION.
DIPHENYL DISTIBENE: EXPLOSIVE OXIDATION.
DIPHENYL TINE: IGNITION REACTION.
2,6-DI-T-BUTYL PHENOL: FORMS EXPLOSIVE COMPOUND.
DIVINYL ETHER: POSSIBLE IGNITION REACTION.VE REACTION.
EPICHLOROHYDRIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ETHANOL: VIOLENT REACTION.
ETHANOL AND SILVER: FORMS EXPLOSIVE PRODUCTS.
M-ETHYL ANILINE: IGNITION REACTION.
ETHYL PHOSPHINE: IGNITION REACTION.
5-ETHYL-2-PICOLINE: FORMS EXPLOSIVE COMPOUNDS.
5-ETHYL-2-METHYL PYRIDINE: EXPLOSIVE REACTION.
ETHYLENE DIAMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
FERROUS OXIDE (POWDERED): INTENSE EXOTHERMIC REACTION.
FLUORINE: POSSIBLE EXPLOSIVE REACTION.POSSIBLE EXPLOSION.
FURFURYL ALCOHOL: IGNITION REACTION.
GERMANIUM: VIOLENT REACTION.
GLYOXAL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
HALOGEN PHOSPHIDES: IGNITION REACTION.
HYDRAZINE: VIOLENT REACTION.
HYDRAZOIC ACID: ENERGETIC REACTION.
HYDROGEN IODIDE: IGNITION REACTION.
HYDROGEN PEROXIDE AND KETONES: FORMS EXPLOSIVE PRODUCTS.
HYDROGEN PEROXIDE AND MERCURIC OXIDE: FORMS EXPLOSIVE COMPOUNDS.
HYDROGEN PEROXIDE AND THIOUREA: FORMS EXPLOSIVE COMPOUNDS.
HYDROGEN SULFIDE: INCANDESCENT REACTION.
INDANE AND SULFURIC ACID: EXPLOSIVE REACTION.
ISOPRENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
LACTIC ACID AND HYDROGEN FLUORIDE: POSSIBLE EXPLOSIVE REACTION.
LITHIUM: IGNITION REACTION.
LITHIUM SILICIDE: INCANDESCENT REACTION.
MAGNESIUM: EXPLOSIVE REACTION.
MAGNESIUM PHOSPHIDE: INCANDESCENT REACTION.
MESITYL OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
MESITYLENE: POSSIBLE EXPLOSIVE REACTION.
METALS: VIOLENT REACTION WITH EXPLOSION OR IGNITION.
METAL CARBIDES: EXPLOSIVE OR VIOLENT REACTION.
METAL FERRICYANIDE OR FERROCYANIDE: INCOMPATIBLE.
METAL SALICYLATES: FORMS EXPLOSIVE COMPOUNDS.
METHANOL: MIXTURES OF GREATER THAN 25% ACID MAY DECOMPOSE VIOLENTLY.
4-METHYLCYCLOHEXANONE: EXPLOSIVE REACTION.
2-METHYL-5-ETHYLPYRIDINE: TEMPERATURE/PRESSURE INCREASE IN CLOSED CONTAINER.
NEODYMIUM PHOSPHIDE: VIOLENT REACTION.
NITRO AROMATIC HYDROCARBONS: FORMS HIGHLY EXPLOSIVE PRODUCTS.
NITROBENZENE: EXPLOSIVE REACTION.
NITROBENZENE AND WATER: EXPLOSIVE REACTION.
NITROMETHANE: EXPLOSIVE REACTION.
NON-METAL OXIDES (ARSINE, PHOSPHINE, TETRABORANE)- EXPLOSIVE REACTION.
OLEUM: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ORGANIC SUBSTANCES AND PERCHLORATES: POSSIBLE EXPLOSION.
ORGANIC SUBSTANCES AND SULFURIC ACID: POSSIBLE EXPLOSION.
PHENYL ACETYLENE AND 1,1-DIMETHYLHYDRAZINE: VIOLENT REACTION.

PHENYL ORTHOPHOSPHORIC ACID DISODIUM SALT: FORMS EXPLOSIVE PRODUCTS.
PHOSPHINE: VIOLENT DECOMPOSITION.
PHOSPHONIUM IODIDE: IGNITION REACTION.
PHOSPHORUS: IGNITION REACTION.
PHOSPHORUS TETRAIODIDE: VIGOROUS REACTION.
PHOSPHORUS TRICHLORIDE: EXPLOSIVE REACTION.
PHTHALIC ACID AND SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
PHTHALIC ANHYDRIDE: EXOTHERMIC REACTION AND FORMS EXPLOSIVE PRODUCTS.
POLYALKENES: INTENSE REACTION..
POLYDIBROMOSILANES: EXPLOSIVE REACTION.
POTASSIUM HYPOPHOSPHITE: EXPLOSIVE REACTION.
B-PROPIOLACTONE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PROPYLENE OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PYRIDINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
REDUCING AGENTS: POSSIBLE EXPLOSIVE OR IGNITION REACTION.
RUBIDIUM CARBIDE: EXPLOSIVE REACTION. POSSIBLE IGNITION REACTION.
SELENIUM: INTENSE REACTION.
SELENIUM HYDRIDE: IGNITION OR INCANDESCENT REACTION.
SELENIUM IODOPHOSPHIDE: EXPLOSIVE REACTION.
SILVER AND ETHYL ALCOHOL: EXPLOSIVE REACTION.
SODIUM: SPONTANEOUS IGNITION.
SODIUM AZIDE: ENERGETIC REACTION.
SULFAMIC ACID: VIOLENT REACTION.
STIBENE: EXPLOSIVE REACTION.
SULFUR DIOXIDE: EXPLOSIVE REACTION.
SULFUR HALIDES: VIOLENT REACTION.
SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
SULFURIC ACID AND GLYCERIDES: EXPLOSIVE REACTION.
SULFURIC ACID AND TEREPHTHALIC ACID: VIOLENT REACTION.
TERPENES: SPONTANEOUS IGNITION.
TETRABORANE: EXPLOSIVE REACTION.
TETRABORANE DECAHYDRATE: EXPLOSIVE REACTION.
THIOALDEHYDES OR THIOKETONES: VIOLENT REACTION.
THIOCYANATES: EXPLOSIVE REACTION.
THIOCYANIC ACID METAL SALTS: EXPLOSIVE REACTION.
THIOPHENES: EXPLOSIVE REACTION.
TITANIUM: FORMS EXPLOSIVE COMPOUND.
TITANIUM ALLOY: POSSIBLE EXPLOSIVE REACTION.
TITANIUM-MAGNESIUM ALLOY: POSSIBLE EXPLOSION ON IMPACT.
TOLUENE: INTENSE OR EXPLOSIVE REACTION.
TOLUENE AND SULFURIC ACID: VIOLENT DECOMPOSITION.
TOLUIDENE: IGNITION REACTION.
TRIAZINE: EXPLOSIVE REACTION.
TRICADMIUM DIPHOSPHIDE: EXPLOSIVE REACTION.
TRIETHYLGALLIUM MONOETHYL ETHER COMPLEX: IGNITION REACTION.
TRIMETHYLTRIOXANE: INTENSE REACTION.
TRITHIOACETONE: EXPLOSIVE REACTION.
UNSYMMETRICAL DIMETHYL HYDRAZINE: EXPLOSIVE REACTION.
URANIUM: EXPLOSIVE REACTION.
URANIUM ALLOY: VIOLENT REACTION.
URANIUM-NEODYMIUM ALLOY: EXPLOSIVE REACTION.
URANIUM-NEODYMIUM-ZIRCONIUM ALLOY: EXPLOSIVE REACTION.
VINYL ACETATE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
VINYLIDENE CHLORIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
P-XYLENE- INTENSE REACTION IN PRESENCE OF SULFURIC ACID.
ZINC- INCANDESCENT REACTION.
ZIRCONIUM-URANIUM ALLOYS: EXPLOSIVE REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY INCLUDE HIGHLY TOXIC OXIDES OF NITROGEN, INCLUDING NITRIC OXIDE AND NITROGEN DIOXIDE, AND HYDROGEN NITRATE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

STORAGE

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

****

CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTS VIOLENTLY WITH WATER AND FUELS. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
COVER WITH SODA ASH. SCOOP UP AND PLACE IN A SUITABLE CONTAINER.

REPORTABLE QUANTITY (RQ): 1000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

NITRIC ACID:

125 MG/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.

250 MG/M3- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT-OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST NITRIC ACID.
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND CARTRIDGE(S) PROVIDING PROTECTION AGAINST NITRIC ACID.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT-OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST NITRIC ACID.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

NOTE: ONLY NON-OXIDIZABLE SORBENTS ARE ALLOWED (NOT CHARCOAL).

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

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 07/03/85 REVISION DATE: 06/29/88

-ADDITIONAL INFORMATION-

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Dw 900. U. 4530

F.C. NO. 44230
44250, 44270, 44350
44370, 44410

MATERIAL SAFETY DATA SHEET
KNEDLER LABORATORIES, INC.
4901 PITTSBURGH AVENUE
FORT WORTH, TEXAS 76119
TELEPHONE 817-457-4477 EMERGENCY TEL.NO.1-424-9300(CHEMTREC)

DATE: 4/4/85

THE MATERIALS LISTED IN THIS DATA SHEET ARE CLASSIFIED IN ACCORDANCE WITH THE DEFINITIONS SET FORTH IN 29CFR PARTS 1915, 1916 AND 1917.

I. PRODUCT NAME: NITRIC ACID, (3+997) : NITRIC ACID, (1+99)
NITRIC ACID, (1+49), ASTM D-2976, FOR COBALT
NITRIC ACID, 0.10N ; NITRIC ACID, 0.01N
NITRIC ACID, NORMALITY SOLUTIONS TO AND INCLUDING 1.0N

CHEMICAL FAMILY: INORGANIC ACID TRADE NAME: (NONE)
DOT SHIPPING NAME: N/A
DOT HAZARD CLASS: N/A DOT I.D. NO.: N/A

II. COMPONENTS: NITRIC ACID...(CAS 7697-37-2)...TO 5.0% N/A NIOSH

III. PERTINENT PHYSICAL DATA:
BOILING PT. 100 C MELTING PT. N/A VAPOR PRESSURE (TYP) 15 AT 20 C.
APPEARANCE AND ODOR: COLORLESS AND ODORLESS LIQUID.

IV. FIRE AND EXPLOSION DATA: REACTS WITH ALUMINUM METAL TO FORM HYDROGEN GAS.

V. HEALTH HAZARD DATA: SEE X

VI. REACTIVITY DATA: KEEP AWAY FROM ORGANIC MATERIALS.

VII. SPILL AND LEAK PROCEDURES: FLUSH WITH A COPIOUS SUPPLY OF WATER.

VIII. SPECIAL PROTECTION INFORMATION: USE NORMAL LABORATORY SAFETY DEVICES.

IX. SPECIAL PRECAUTIONARY INFORMATION: USE PRUDENT LABORATORY PROCEDURES.

X. FIRST AID AND OTHER PROCEDURES: EXTERNAL: IMMEDIATELY FLUSH SKIN OR EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FOR EYES: GET MEDICAL ATTENTION. INTERNAL: DO NOT GIVE EMETICS OR BAKING SODA. GIVE TAP WATER, MILK, OR MILK OF MAGNESIA. GIVE WHITES OF EGGS BEATEN WITH WATER. CALL A PHYSICIAN.

DISCLAIMER OF LIABILITY

THE INFORMATION IN THIS MSDS WAS OBTAINED FROM SOURCES WHICH WE BELIEVE ARE RELIABLE. HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, REGARDING ITS ACCURACY OR CORRECTNESS.

THE CONDITIONS OR METHODS OF HANDLING, STORAGE, USE AND DISPOSAL OF THE PRODUCT ARE BEYOND OUR CONTROL AND MAY BE BEYOND OUR KNOWLEDGE. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY DIRECTLY OR INDIRECTLY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT OR THE INFORMATION FURNISHED THEREWITH.***

J.T.BAKER INC., 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: NITRIC ACID
COMMON SYNONYMS: HYDROGEN NITRATE; AZOTIC ACID
CHEMICAL FAMILY: INORGANIC ACIDS
FORMULA: HNO3
FORMULA WT.: 63.01
CAS NO.: 7697-37-2
NIOSH/RTECS NO.: QU5775000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 4801,9597,5113,9602,5371,9598,9605,9600,9616,6901,9606,9601

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

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

LABORATORY PROTECTIVE EQUIPMENT

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

U.S. PRECAUTIONARY LABELING

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.
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.

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PRECAUTIONARY LABELING (CONTINUED)

INTERNATIONAL LABELING

AVOID CONTACT WITH EYES. AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH PLENTY OF WATER. KEEP CONTAINER TIGHTLY CLOSED.

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

SECTION II - COMPONENTS

COMPONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
NITRIC ACID	7697-37-2	65-71	2 PPM	2 PPM
WATER	7732-18-5	29-35	N/E	N/E

SECTION III - PHYSICAL DATA

BOILING POINT: 121 C (249 F)
(AT 760 MM HG)

VAPOR PRESSURE (MMHG): 9
(20 C)

MELTING POINT: -42 C (-43 F)
(AT 760 MM HG)

VAPOR DENSITY (AIR=1): N/A

SPECIFIC GRAVITY: 1.41
(H2O=1)

EVAPORATION RATE: N/A

SOLUBILITY(H2O): COMPLETE (100%)

% VOLATILES BY VOLUME: 100
(21 C)

PH: N/A

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: LIQUID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID. SUFFOCATING ODOR.

CONTINUED ON PAGE: 3

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): N/A NFPA 704M RATING: 3-0-0 OXY

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINGUISHING MEDIA
USE WATER SPRAY.

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
OXIDES OF NITROGEN, HYDROGEN

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT
NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE
NONE IDENTIFIED.

SECTION V - 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)

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SECTION V - HEALTH HAZARD DATA (CONTINUED)

TOXICITY OF COMPONENTS

INTRAPERITONEAL MOUSE LD50 FOR WATER	190	G/KG
INTRAVENOUS MOUSE LD50 FOR WATER	25	G/KG

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

CARCINOGENICITY
NONE IDENTIFIED.

REPRODUCTIVE EFFECTS
NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: SEVERE IRRITATION OR BURNS OF RESPIRATORY SYSTEM, COUGHING, DIFFICULT BREATHING, CHEST PAINS, PULMONARY EDEMA, LUNG INFLAMMATION, UNCONSCIOUSNESS, AND MAY BE FATAL

SKIN CONTACT: SEVERE IRRITATION OR BURNS

EYE CONTACT: SEVERE IRRITATION OR BURNS

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: NAUSEA, VOMITING, SEVERE BURNS, ULCERATION - MOUTH, THROAT, STOMACH, AND MAY BE FATAL

CHRONIC EFFECTS: DAMAGE TO LUNGS, TEETH

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

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

CONTINUED ON PAGE: 5

SECTION V - HEALTH HAZARD DATA (CONTINUED)

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, DO NOT INDUCE VOMITING. IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.

INHALATION: IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE RE-USE.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: YES PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE:	YES	CONTAINS NITRIC ACID (RQ = 1,000 LBS, TPQ = 1,000 LBS)
CERCLA HAZARDOUS SUBSTANCE:	YES	CONTAINS NITRIC ACID (RQ = 1000 LBS)
TOXIC CHEMICALS:	YES	CONTAINS NITRIC ACID
GENERIC CLASS:		C16
TSCA INVENTORY:	YES	

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, LIGHT, MOISTURE

INCOMPATIBLES: 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

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SECTION VII - SPILL & 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, 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)

SECTION VIII - INDUSTRIAL 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.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

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

STORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. STORE SEPARATELY AND AWAY FROM FLAMMABLE AND COMBUSTIBLE MATERIALS. ISOLATE FROM INCOMPATIBLE MATERIALS. KEEP PRODUCT OUT OF LIGHT.

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SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: NITRIC ACID (OVER 40%)
HAZARD CLASS: OXIDIZER
UN/NA: UN2031 REPORTABLE QUANTITY: 1000 LBS.
LABELS: OXIDIZER, CORROSIVE
REGULATORY REFERENCES: 49CFR 172.101; 173.268

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: NITRIC ACID
HAZARD CLASS: 8 I.M.O. PAGE: 8107
UN: UN2031 MARINE POLLUTANTS: NO PACKAGING GROUP: II
LABELS: CORROSIVE
REGULATORY REFERENCES: 49CFR 172.102; PART 176; IMO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: NITRIC ACID
HAZARD CLASS: 8
UN: UN2031 PACKAGING GROUP: II
LABELS: CORROSIVE
REGULATORY REFERENCES: 49CFR 172.101; 173.6; PART 175; ICAO/IATA

U.S. CUSTOMS HARMONIZATION NUMBER: 28080000000

N/A = NOT APPLICABLE OR NOT AVAILABLE
N/E = NOT ESTABLISHED

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.
EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES

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ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.
THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET. IF YOU HAVE ANY QUESTIONS, PLEASE CALL CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

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APPROVED BY QUALITY ASSURANCE DEPARTMENT.

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J. T. BAKER CHEMICAL CO. 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865

M A T E R I A L S A F E T Y D A T A S H E E T

24-HOUR EMERGENCY TELEPHONE -- (201) 859-2151

CHEMTREC # (800) 424-9300 -- NATIONAL RESPONSE CENTER # (800) 424-8802

N3660 -01 NITRIC ACID

EFFECTIVE: 10/01/85 ISSUED: 01/23/86

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: NITRIC ACID
FORMULA: HNO3
FORMULA WT: 63.01
CAS NO.: 07697-37-2
NIOSH/RTECS NO.: QU5775000
COMMON SYNONYMS: HYDROGEN NITRATE
PRODUCT CODES: 4801,9602,9598,9606,5371,9597,9600,5113,9616,9605,9601

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	(POISON)
FLAMMABILITY	-	0	
REACTIVITY	-	3	(OXIDIZER)
CONTACT	-	4	(CORROSIVE)

LABORATORY PROTECTIVE EQUIPMENT

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

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
STRONG OXIDIZER - CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE
LIQUID AND VAPOR CAUSE SEVERE BURNS - MAY BE FATAL IF SWALLOWED
HARMFUL IF INHALED AND MAY CAUSE DELAYED LUNG INJURY
SPILLAGE MAY CAUSE FIRE OR LIBERATE DANGEROUS GAS

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, FLOOD WITH WATER. FLUSH SPILL AREA WITH WATER SPRAY.

SECTION II - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
NITRIC ACID	65-75	7697-37-2

SECTION III - PHYSICAL DATA

BOILING POINT: 120 C (248 F)
VAPOR PRESSURE(MM HG): 2.9

MELTING POINT: -42 C (-44 F)
VAPOR DENSITY(AIR=1): 2.5

SPECIFIC GRAVITY: 1.50 (H2O=1)
EVAPORATION RATE: N/A (BUTYL ACETATE=1)

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SECTION III - PHYSICAL DATA (CONTINUED)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID, WITH CHOKING ODOR.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: N/A NFPA 704M RATING: 3-0-0 OXY

FIRE EXTINGUISHING MEDIA
USE WATER SPRAY.

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
STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.

TOXIC GASES PRODUCED
NITROGEN OXIDES

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 5 MG/M3 (2 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 10 MG/M3 (4 PPM)

EFFECTS OF OVEREXPOSURE
LIQUID MAY CAUSE SEVERE BURNS TO SKIN AND EYES.
INHALATION OF VAPORS MAY CAUSE SEVERE IRRITATION OF THE RESPIRATORY SYSTEM
INHALATION OF VAPORS MAY CAUSE COUGHING, CHEST PAINS, DIFFICULTY BREATHING OR UNCONSCIOUSNESS.
INGESTION MAY BE FATAL.

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 FO AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

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SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, LIGHT

INCOMPATIBLES: STRONG BASES, COMBUSTIBLE MATERIALS, STRONG REDUCING AGENTS

DECOMPOSITION PRODUCTS: OXIDES OF NITROGEN

SECTION VII - 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. STO LEAK IF YOU CAN DO SO WITHOUT RISK. VENTILATE AREA. NEUTRALIZE SPILL WIT SODA ASH OR LIME. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, 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 NEUTRASOL(R) "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: D002, D003 (CORROSIVE, REACTIVE WASTE)

SECTION VIII - 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, ACID-RESISTANT GLOVES ARE RECOMMENDED.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

^AF-T-DATA(TM) STORAGE COLOR CODE: YELLOW

SPECIAL PRECAUTIONS

KEEP CONTAINER TIGHTLY CLOSED. STORE SEPARATELY AND AWAY FROM FLAMMABLE

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SECTION IX - STORAGE AND HANDLING PRECAUTIONS (CONTINUED)

AND COMBUSTIBLE MATERIALS.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	NITRIC ACID (OVER 40%)
HAZARD CLASS	OXIDIZER
UN/NA	UN2031
LABELS	OXIDIZER, CORROSIVE
REPORTABLE QUANTITY	1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	NITRIC ACID
HAZARD CLASS	8
UN/NA	UN2031
LABELS	CORROSIVE

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

THE INFORMATION PUBLISHED IN THIS MATERIAL SAFETY DATA SHEET HAS BEEN COMPILED FROM OUR EXPERIENCE AND DATA PRESENTED IN VARIOUS TECHNICAL PUBLICATIONS. IT IS THE USER'S RESPONSIBILITY TO DETERMINE THE SUITABILITY OF THIS INFORMATION FOR THE ADOPTION OF NECESSARY SAFETY PRECAUTIONS. WE RESERVE THE RIGHT TO REVISE MATERIAL SAFETY DATA SHEETS PERIODICALLY AS NEW INFORMATION BECOMES AVAILABLE.

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