HEALTH AND SAFETY PLAN
TITANIUM METALS CORPORATION FACILITY
HENDERSON, NEVADA

Submitted to

NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
Bureau of Corrective Actions
2030 E. Flamingo Road, Suite 230
Las Vegas, NV 89119

Project No.	:	P3554
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REVIEWS AND APPROVALS
PROJECT NO.: P3554
TITANIUM METALS CORPORATION FACILITY
HENDERSON, NEVADA

We the undersigned have read and approve of the health and safety guidelines presented in this health and safety plan for on-site work activities at the Titanium Metals Corporation site.

Name	Signature	Date
David Brown Tetra Tech Health and Safety Representative		August 14, 2007
Candy Friday Tetra Tech Project Manager		August 14, 2007

This certifies that Tetra Tech has assessed the type, risk level, and severity of hazards for the project and has selected appropriate personal protective equipment for site personnel in accordance with Occupational Safety and Health Administration Title 29 of the *Code of Federal Regulations*, Part 1910.132.

Certified by

David Brown Tetra Tech Technical Reviewer		August 14, 2007

EMERGENCY INFORMATION
POST ON SITE
EMERGENCY CONTACTS AND ROUTE TO HOSPITAL

TITANIUM METALS CORPORATION FACILITY
HENDERSON, NEVADA

Emergency Contact	**Telephone No.**
U.S. Coast Guard National Response Center	(800) 424-8802
InfoTrac Chemical Monitoring System	(800) 535-5053
WorkCare	(800) 455-6155
Fire Department	911
Police Department	911
Health & Safety Personnel:	
Human Resource Development: Diane Stopa, Tetra Tech	(703) 390-0636
Health and Safety Representative: David Brown, Tetra Tech	(619) 321-6722
Office Health and Safety Coordinator: Courtney Nichols, Tetra Tech	(832) 251-5181
TIMET Project Manager: Victoria Tyson, Tyson Contracting	(702) 219-1348
Tetra Tech Project Manager: Candy Friday, Tetra Tech	(832) 251-5166
Site Safety Coordinator: Courtney Nichols, Tetra Tech	(832) 251-5181
Titanium Metals Corporation:	
Craig Wilkinson, Manager	(702) 465-2544
Medical Emergency	
Hospital Name: St. Rose Dominican Hospital Rosa de Lima Campus	
Hospital Address: 102 East Lake Mead Drive Henderson, Nevada	
Hospital Telephone No.:	Emergency - 911 General – (702) 564-2622
Ambulance Telephone No.:	911
Route to Hospital: (see next page hospital route map) From plant entrance, proceed east/northeast on Lake Mead Drive about ½ mile until you reach the hospital.	

Note: This sheet must be posted on site.

EMERGENCY INFORMATION
POST ON SITE
HOSPITAL ROUTE MAP

ST. ROSE DOMINICAN HOSPITAL ROSA DE LIMA CAMPUS
102 EAST LAKE MEAD DRIVE
HENDERSON, NEVADA

Note: This sheet must be posted on site.

1.0 INTRODUCTION

Titanium Metals Corporation (TIMET) has an environmental management team composed of several consulting firms; including Tetra Tech EM Inc. (Tetra Tech) to conduct site investigations at the TIMET facility in Henderson, Nevada. The site-specific health and safety provisions in this document have been developed for use as a generic plan during the various environmental investigations conducted at TIMET facility. This document addresses items specified under Occupational Safety and Health Administration (OSHA) Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.120 (b), "Final Rule." This health and safety plan (HASP) will be available to all on-site personnel who may be exposed to hazardous on-site conditions, including Tetra Tech employees participating in investigations, and all site visitors, including regulatory agency representatives.

The purpose of this HASP is to define requirements and designate protocols to be followed during the investigations at the TIMET facility. All personnel on site must be informed of site emergency response procedures and any potential fire, explosion, health, or safety hazards associated with on-site activities. This HASP summarizes potential hazards and defines protective measures planned for typical site activities. Should an investigation arise that has specific health and safety issues not addressed in this generic HASP, a task-specific HASP will be required to address all know issues that are not addressed herein.

This plan must be reviewed and approved by the health and safety representative (HSR) or a designee and the Tetra Tech project manager (see the Reviews and Approvals form after the Contents in this document). The Compliance Agreement form in Appendix A must be signed by all personnel before they enter the site. Protocols established in this HASP are based on site conditions and health and safety hazards known or anticipated to be present and on available site data. Specifications herein are subject to review and revision based on actual conditions encountered in the field during site activities. Significant revisions to this plan must be approved by the Tetra Tech project manager and the HSR. This HASP will be reviewed and revised, if necessary, every three years; or more often if conditions or activities change significantly.

Tetra Tech employees must also follow safety requirements taught during safety training and described in the Tetra Tech, Inc., "Health and Safety Manual." Tetra Tech has prepared this HASP solely for the protection of Tetra Tech employees. Subcontractors, visitors, and others, while required to follow provisions in this HASP, at a minimum should consult the HASP prepared by their companies or

organizations for their protection. Tetra Tech assumes no liability for the health and safety of any person on this jobsite other than Tetra Tech employees.

2.0 HEALTH AND SAFETY PERSONNEL AND PLAN ENFORCEMENT

This section describes responsibilities of project personnel, summarizes requirements for subcontractors and visitors who wish to enter TIMET facility, and discusses HASP enforcement.

2.1 PROJECT PERSONNEL

The following personnel and organizations are associated with planned activities at the site. The organizational structure will be reviewed and updated as necessary during the course of the project.

Name/Title	Responsibility	Telephone No.
Client Emergency Contact:		
Craig Wilkinson TIMET	Environmental and Health and Safety Manager	(702) 465-2544
Tetra Tech Personnel:		
Candy Friday Tetra Tech	Project QA Manager/Chemist	(832) 251-5166
David Brown Tetra Tech	HSR	(619) 321-6722
Courtney Nichols Tetra Tech	On-site Health and Safety Officer (OSHO)	(832) 251-5181
To be determined on a project-specific basis	Field Team Leader	To be determined

The Tetra Tech project manager, field team leader, OSHO, and HSR will be responsible for implementation and enforcement of the provisions of this HASP. Their duties and the expectations for project team members are described in the following sections.

2.1.1 Project Manager and Field Team Leader

The Tetra Tech project manager has ultimate responsibility for ensuring implementation of the requirements set forth in this HASP. Some of this responsibility may be achieved through delegation to site-dedicated personnel that report directly to the project manager. The project manager shall regularly confer with site personnel regarding safety and health compliance.

The Tetra Tech field team leader will oversee and direct field activities and has day-to-day responsibility for ensuring implementation of the HASP. Subcontractor compliance with the HASP shall be monitored by the field team leader. The field team leader will report directly to the project manager any health and safety-related issues.

2.1.2 On-site Health and Safety Officer

The OSHO will be appointed by the project manager and will be responsible for field implementation of tasks and procedures contained in this HASP, including air monitoring, establishing a decontamination protocol, and ensuring the signing of the Daily Tailgate Safety Meeting form (Form HST-2) and the Compliance Agreement (Form HSP-4) (see Appendix A) by all personnel working on site. The OSHO will have advanced fieldwork experience and be familiar with health and safety requirements specific to the project. The OSHO will also maintain the Daily Site Log (Form SSC-1 in Appendix A).

2.1.3 Health and Safety Representative

The HSR is responsible for administration of the company health and safety program. The HSR will act in an advisory capacity to project managers and site personnel for project-specific health and safety issues. The Tetra Tech project manager will establish a liaison between officers and representatives of TIMET and the HSR on matters relating to health and safety.

2.1.4 Tetra Tech Employees

Tetra Tech employees are expected to fully participate in implementing the site HASP by obtaining necessary training, attending site safety meetings, always wearing designated personal protective equipment (PPE), complying with site safety and health rules, and advising the OSHO of health and safety concerns at the site.

2.2 SUBCONTRACTORS

Subcontractor personnel participating in environmental investigation activities will be required to read and comply with all sections of this plan. All subcontractor personnel entering the site must sign the Compliance Agreement form (see Appendix A). Subcontractor personnel must comply with all applicable 29 CFR 1910.120 training, fit testing, and medical surveillance requirements. Subcontractors are responsible for providing PPE required by this plan for their personnel (see Section 6.1, Protective Equipment and Clothing) and are directly responsible for the health and safety of their employees.

2.3 VISITORS

All site visitors will be required to read the HASP and sign the Compliance Agreement form (see Appendix A). Visitors will be expected to comply with relevant OSHA requirements. Visitors will also be expected to provide their own PPE required by the HASP. Visitors who have not met OSHA training, medical surveillance, and PPE requirements are not permitted to enter areas where exposure to hazardous materials is possible.

2.4 HEALTH AND SAFETY PLAN ENFORCEMENT

This HASP applies to all environmental investigation activities and all personnel working on the investigation at the TIMET facility. HASP enforcement shall be rigorous. Violators of the HASP will be verbally notified upon first violation, and the violation will be noted by the OSHO in a field logbook. Upon second violation, the violator will be notified in writing, and the Tetra Tech project manager and the violator's supervisor will be notified. A third violation will result in a written notification and violator's eviction from the site. The written notification will be sent to human resources development and the HSR.

Personnel will be encouraged to report to the OSHO any conditions or practices that they consider to be detrimental to their health or safety or they believe are in violation of applicable health and safety standards. Such reports may be made orally or in writing. Personnel who believe that an imminent danger threatens human health or the environment will be encouraged to bring the matter to the immediate attention of the OSHO for resolution.

At least one copy of this HASP will be available to all site personnel at all times. Minor changes in HASP procedures will be discussed at the beginning of each workday by the OSHO at the daily tailgate safety meeting. Significant plan revisions must be discussed with the HSR and project manager.

3.0 SITE BACKGROUND

In a letter to TIMET dated December 11, 2003, the State of Nevada, Division of Environmental Protection (NDEP) requested that accelerated work be performed at the TIMET site to identify and characterize site-related chemicals in groundwater at the site boundary and their migration on and downgradient from the Plant Site and the Pabco Road Ponds Area (Tetra Tech 2004a). The purpose of any environmental investigation at TIMET is to obtain the additional soil, groundwater, and geologic

characterization data that are needed to evaluate the fate and transport of contaminants in groundwater leaving site.

The following sections describe the TIMET site, its history, and activities planned for this project.

3.1 SITE DESCRIPTION

The TIMET facility, which is part of the Basic Metals, Inc. (BMI) Industrial Complex, is located in unincorporated Clark County, Nevada, about 13 miles southeast of Las Vegas and immediately northwest of the city of Henderson (Figure 1) (Tetra Tech 2004a). TIMET is one of six companies that operated a facility within the BMI Industrial Complex in Henderson. For the purposes of this HASP, the TIMET site comprises the Plant Site and areas downgradient to the Las Vegas Wash (Figure 2).

TIMET Plant Site

The Plant Site (Figure 2) has an area of about 180 acres and includes management and operations buildings, process buildings and units, maintenance shops, landfills, material and equipment storage areas, retention ponds, tanks, and roads and railroads (Tetra Tech 2004a). The Plant Site is mainly used for the manufacture of titanium industrial products, including titanium sponge, ingot, and titanium tetrachloride. This process includes reacting titanium oxide with chlorine in the presence of coke to produce titanium tetrachloride and subsequently reducing titanium by reacting the titanium tetrachloride with magnesium. The magnesium and chlorine are recovered as molten magnesium metal and chlorine gas from the magnesium chloride generated in the titanium reduction process by passing an electrical current into an electrolytic cell.

Potential source areas and receiving waste streams at the TIMET Plant Site included the following:

- J-2 and S-17 Landfill Areas generally received nonhazardous solid plant wastes and construction debris
- Pioche Managanese Landfill S-20 was used to stockpile manganese slag

- Continuous sludge dryer (CSD) North and South Ponds received CSD solids slurry with other process wastewater (OPW)
- CSD Old Caustic Pond received caustic wastewater
- J-9 Tailings Pond received magnesium manufacturing wastes
- Francy's Mountain was used to stockpile about 8,600 cubic yards of mixed chlorinator dust and CSD solids
- Northern Storage Area received solids from CSD North/South Ponds and Old Caustic Pond, as well as miscellaneous debris such as reactor lids, brisk, asbestos, and coke
- Harvest Pond (HP)-1 and Salt Water (SW)-1 (formerly North and South Nitrate Ponds) both received leach liquor; Pond SW-1 also received OPW liquid wastes
- HP-6 Pond was used for evaporation of leach liquor and spent caustic wastewater
- Transformer Storage Area was used as a storage area for non-polychlorinated biphenyl (PCB) and PCB transformers
- Various subsurface piping and former drainage ditches used to convey hazardous and nonhazardous wastewaters.

Currently, the CSD ponds are dry and not in use (Tetra Tech 2004a). The CSD waste stream is discharged as a slurry and evaporated in Pabco Road Pond SW-8. No volatile organic compounds (VOC) or semivolatile organic compounds (SVOC) were used or discharged into the CSD waste stream. Analysis of the waste stream indicates that the wastewater contained total dissolved solids including magnesium, sodium, and potassium chlorides, as well as nitrates, chromium, iron, sulfate, and other residual metals. TCLP and EP toxicity analyses of CSD solids collected by TIMET from 1989 through 1991 indicate that the CSD solids are not characteristic hazardous waste. The TIMET data indicate that the CSD waste stream contains concentrations of various metals and other inorganic compounds. The CSD solids may contain radionuclides in concentrations that are typical of ore processing byproducts.

Analysis of groundwater samples collected during recent quarterly groundwater sampling within the TIMET Plant Site detected the following concentrations of contaminants (Tetra Tech 2004b):

- Arsenic at 562 micrograms per liter (µg/L)
- Chromium at 1,230 µg/L

- Total uranium at 1,160 µg/L
- Vanadium at 294 µg/L
- Chloroform at 1,600 µg/L
- Tetrachloroethene at 83 µg/L
- Total trihalomethanes at 1,699 µg/L
- Radon 222 at 1,640 picoCuries per liter (pCi/L)

3.2 SITE HISTORY

In 1991, the NDEP entered into Consent Agreements with the firms that operated facilities at the BMI Industrial Complex to address source areas of contamination and off-site migration of site-related contaminants (Tetra Tech 2004a). Present and former owners and operators entering into this agreement included TIMET; Chemstar Corporation; Kerr-McGee Chemical Corporation (Kerr-McGee); Montrose Chemical Corporation of California, Inc. (Montrose); Pioneer Chlor Alkali Company, Inc. (Pioneer); and Stauffer Management Company, Inc. (Stauffer). By 1993, TIMET had completed the Phase I environmental conditions assessment (ECA), and NDEP issued a letter of understanding (LOU) in August 1994 that identified study items requiring additional investigation. In June 1996, NDEP entered into a Consent Agreement with TIMET to perform an environmental conditions investigation (ECI), remedial alternative studies, interim remedial measures, and/or additional work. In 2003, NDEP recommended initiating an accelerated work schedule to abate, mitigate, and eliminate environmental contaminants.

TIMET Plant Site

Prior to 1976, the CSD North and South Ponds were earthen bermed and unlined (Tetra Tech 2004a). The current ponds (0.5 acre each, single-lined with Gilsabine asphalt liners) were constructed in approximately 1976. From the 1950s to the 1970s, the old CSD ponds received wastes from the chlorination process (chlorinator cooling water, scrubber water with hydrochloric acid, suspended titanium dioxide and condenser wash water), the scrap reclaim process (detergent washer water) and the purification process (purification ventilation system scrubber water) through a “sludge disposal line.” Beginning in the 1970s, the CSD solids were slurried with OPW effluent, sponge wash water, wet scrubber effluent from the leaching process, and make-up water from the chlorination process wash

towers, then discharged to the CSD North and South Ponds for sedimentation. The primary waste components of the OPW effluent included hydrochloric acid, titanium dioxide solids, chlorides, sulfates, and trace metals. Separated liquids from the CSD Ponds were pumped to SW-1 Pond and various Pabco Road ponds for evaporation (located over ½ mile northeast of the CSD Ponds). From the 1970s until the early 1990s, the solids dredged from the CSD Ponds were disposed in OPW Ponds 6 through 20 in the Pabco Ponds Area (located about 1 mile northeast of the CSD Ponds).

3.3 PLANNED ACTIVITIES

Field activities to be performed during the typical environmental investigations at TIMET include the following tasks:

- Install stratigraphic borings and groundwater monitoring wells using direct push, hollow-stem auger, mud rotary, or sonic drilling technologies
- Sample soil and groundwater, for chemical analysis and measurement of water levels in wells
- Survey existing and new wells and boring locations
- Conduct aquifer testing

These activities will be conducted at various times and for various purposes between 2007 and 2010.

4.0 SITE-SPECIFIC HAZARD EVALUATION

Field activities and physical features of the site may expose field personnel to a variety of hazards. This section provides information on potential hazards related to site activities and the nature of hazardous material impacts. Potential chemical and physical hazards, as well as biohazards, related to site activities are discussed below.

4.1 CHEMICAL HAZARDS

Chemicals that may be present at the site are listed in Table 1. These chemicals pose various physical, chemical, and toxicological hazards. Potential routes of exposure include dermal (skin) contact, inhalation, and ingestion. The chemicals may also contaminate equipment, vehicles, instruments, and personnel. The overall health threat from exposure to these chemicals is uncertain because (1) actual concentrations that personnel could be exposed to cannot be predicted, (2) the actual duration of exposure

is unknown, and (3) the effects of low-level exposure to a mixture of chemicals cannot be predicted. However, the potential for high-level exposure is limited.

Specific information on potential chemical hazards at the site is provided in Table 1, including exposure limits, anticipated exposure routes, and toxic characteristics. Table 2 provides a task hazard analysis of the planned field activities listed in Section 3.3.

The Material Safety Data Sheets (MSDS) included in the attachment to this HASP summarize health and safety information for hazardous materials that will be brought to the site, such as laboratory reagents, decontamination solutions, and sample preservatives. These materials are as follows:

- Liquinox (decontamination detergent)
- Hydrochloric acid (sample preservative)
- Nitric acid (sample preservative)

4.2 PHYSICAL HAZARDS

Physical hazards associated with site activities present a potential threat to on-site personnel. Dangers are posed by heavy equipment, utility and power lines, slippery surfaces, unseen obstacles, noise, heat, cold, and poor illumination.

Injuries may result, for example, from the following:

- Accidents caused by slipping, tripping, or falling
- Use of improper lifting techniques

TABLE 1

POTENTIAL CHEMICAL HAZARDS
TITANIUM METALS CORPORATION FACILITY, HENDERSON, NEVADA

Chemical and Media	Exposure Limits/IDLH Level	Exposure Routes	Toxic Characteristics
Arsenic (in groundwater)	PEL = 0.010 mg/m^3 REL = 0.002 mg/m^3 IDLH = 5 mg/m^3	Eye/skin contact Ingestion	Ulceration of nasal septum; dermatitis; GI disturbances; peripheral neuropathy; respiratory irritation; hyperpigmentation of skin; carcinogen
Chromium (trivalent) (in groundwater)	PEL = 0.5 mg/m^3 IDLH = 25 mg/m^3	Eye/skin contact Ingestion	Irritation to eyes; sensitization dermatitis
Titanium dioxide (as a particulate in air)	PEL = 15 mg/m^3 IDLH = 5,000 mg/m^3	Inhalation	Lung fibrosis; carcinogen
Uranium (soluble) (in groundwater)	PEL/REL = 0.05 mg/m^3 IDLH = 10 mg/m^3	Eye/skin contact Ingestion	Lacrimation, conjunctivitis; shortness of breath, cough, chest rales; nausea, vomiting; skin burns; red blood cell casts in urine, albuminuria, high blood urea nitrogen; (potential for cancer is a result of alpha-emitting properties, and radioactive decay products, e.g., radon)
Vanadium (in groundwater)	PEL = 0.5 mg/m^3 REL = 0.05 mg/m^3 IDLH = 35 mg/m^3	Eye/skin contact Ingestion	Irritation to eyes/skin/throat; green tongue, metallic taste, eczema; cough; fine rales, wheezing, bronchitis, dyspnea (breathing difficulty)
General Dust	PEL = 15 mg/m^3 (total fraction) PEL = 5 mg/m^3 (respirable fraction)	Inhalation	At high concentrations, otherwise nontoxic particulates may cause alveolar proteinosis; at lower concentrations, elevated dust levels may inhibit clearance of particles from the lungs by decreasing mobility of alveolar macrophages.
Radon 222 (as ionizing radiation in groundwater)	100 µR/hour based on maximum of 1,000 hours annually; 1,250 mrem/quarter, based on 5,000 mrem/year	Eye/skin contact Absorption Ingestion	Lacrimation, conjunctivitis; shortness of breath, cough, chest rales; nausea, vomiting; skin burns; red blood cell casts in urine, albuminuria, high blood urea nitrogen; carcinogen ***Based on past surveys of the areas proposed for sampling, the action limit for radionuclides is not expected to be exceeded.***
Chloroform (in groundwater)	STEL = 2 ppm (60-minute) Ceiling = 50 ppm IDLH = 500 ppm	Inhalation Eye/skin contact Ingestion	Skin and eye irritation; dizziness, mental dullness, nausea, confusion; headache, fatigue; anesthesia; enlarged liver; carcinogen

TABLE 1 (Continued)

POTENTIAL CHEMICAL HAZARDS
TITANIUM METALS CORPORATION FACILITY, HENDERSON, NEVADA

Chemical and Media	Exposure Limits/IDLH Level	Exposure Routes	Toxic Characteristics
Tetrachloroethene (in groundwater)	PEL = 100 ppm Ceiling = 200 ppm IDLH = 150 ppm	Inhalation Eye/skin contact Absorption Ingestion	Irritated eyes, nose, throat; nausea; flushed face, neck; vertigo, dizziness, incoordination; headache; somnolence; skin erythema; liver damage; carcinogen
Trichloroethene (in groundwater)	PEL = 100 ppm Ceiling = 200 ppm IDLH = 1,000 ppm	Inhalation Eye/skin contact Ingestion	Eye/skin irritant; headache, vertigo; visual distortion, fatigue, giddiness, tremors; nausea, vomiting; dermatitis; paresthesia; cardiac arrhythmia; carcinogen
Trihalomethanes (in groundwater)	PEL/REL = 1,000 ppm IDLH = 40,000 ppm	Inhalation Eye/skin contact Ingestion	Dizziness, tremors, asphyxia; unconsciousness; cardiac arrhythmias, cardiac arrest; irritated respiratory system; ringing in ears; liquid: frostbite

Notes:

ACGIH	American Conference of Governmental Industrial Hygienists
CARC	Carcinogen
CNS	Central nervous system
fiber/cm^3	Fiber per cubic centimeter
GI	Gastrointestinal
IDLH	Immediately dangerous to life or health
mg/m^3	Milligram per cubic meter
mrem	Millirem
NCRP	National Council on Radiation Protection and Measurements
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible exposure limit
ppm	Part per million
REL	Recommended exposure limit
rem	Roentgen equivalent man
µR	MicroRoentgen

Sources: ACGIH 2002, NCRP 1993, and NIOSH 1997

TABLE 2

TASK HAZARD ANALYSIS
TITANIUM METALS CORPORATION FACILITY, HENDERSON, NEVADA

Task	Potential Hazard	Controls	Initial Level of Protection	Upgraded Level of Protection
General Site Hazards	Driving on the site	Obey all traffic rules.	Level D	Not required
	Working with or near heavy equipment	Be aware of heavy equipment activity and follow SWP 6-26 "Use of Heavy Equipment."		
	Eye injury and overhead hazards	Wear safety glasses and hard hats.		
	Noise	Wear hearing protection.		
	Slips, trips, falls	Wear proper footwear, watch for uneven terrain, and follow guidelines in SWP 6-9 "Fall Protection Practices" and SWP 6-10 "Portable Ladder Safety."		
	Poisonous plants, insects, or snakes	Follow guidelines in SWP 6-17 "Biohazards."		
	Heat stress	Follow guidelines in SWP 6-15 "Heat Stress."		
	Cold stress	Follow guidelines in SWP 6-16 "Cold Stress."		
Survey existing and new wells	General site hazards	Refer to general site hazards.	Level D	Level D (when contacting potentially contaminated surfaces) . Nitrile gloves . Tyvek coveralls (as determined by OSHO) . Boot covers (as determined by OSHO)
	Contact with potentially contaminated surfaces	Upgrade PPE.		

TABLE 2 (Continued)

TASK HAZARD ANALYSIS
TITANIUM METALS CORPORATION FACILITY, HENDERSON, NEVADA

Task	Potential Hazard	Controls	Initial Level of Protection	Upgraded Level of Protection
Sample soil and groundwater, to include measurement of water levels in wells Conduct aquifer testing IDW management	General site hazards Inhalation/ingestion of particulates/vapors Chemical hazards	Refer to general site hazards. Remain upgradient of intrusive activity, initiate dust suppression, and/ or monitor air in breathing zone; upgrade to Level C.	Level D . Nitrile gloves . Eye protection . Tyvek coveralls (as determined by OSHO) . Boot covers (as determined by OSHO)	Level C . Chemical hazard exists . Full- or half-face APR with GMC organic vapor/acid/P100 cartridges . Nitrile gloves . Tyvek coveralls (as determined by OSHO) . Boot covers (as determined by OSHO)
Install stratigraphic borings and groundwater monitoring wells using direct push, hollow-stem auger, sonic, and mud rotary technologies, develop wells IDW management	General site hazards Inhalation/ingestion of particulates/vapors Chemical hazards Physical hazards from heavy machinery use Explosive hazard from invasive activities at or near landfills	Refer to general site hazards. Remain upwind of intrusive activity, initiate dust suppression, and/ or monitor air in breathing zone; upgrade to Level C. Establish and mark work zones to exclude unauthorized personnel in potentially hazardous areas. Refer to SWP 6-3 "Safe Drilling Practices."	Level D . Nitrile gloves . Eye protection . Tyvek coveralls (as determined by OSHO) . Boot covers (as determined by OSHO)	Level C . Chemical hazard exists . Full- or half-face APR with GMC organic vapor/acid/P100 cartridges . Nitrile gloves . Tyvek coveralls (as determined by OSHO) . Boot covers (as determined by OSHO)

Notes:

For the purpose of respiratory protection from respirable dust, a dust mask may be worn. Where excessive dust is present, personnel should consider the use of half- or full-face APR with P100 filter (formerly known as a HEPA air filter) and protective goggles.

APR Air-purifying respirator
HEPA High-efficiency particulate air
PEL Permissible exposure limit (see Table 1)
SWP Safe work practice (see Section 9.5

- Moving or rotating equipment
- Equipment mobilization and operation (such as electrocution from contact with overhead or underground power lines)
- Improperly maintained equipment

Injuries resulting from physical hazards can be avoided by using safe work practices (SWP) and employing caution when working with machinery. Specific SWPs applicable to the TIMET site are listed in Section 9.5 and are provided in Appendix B of this HASP. To ensure a safe workplace, the OSHO will conduct and document regular safety inspections on a field audit checklist (Form AF-1) and will make sure that all project team workers and visitors are informed of any potential physical hazards related to the site.

Physical hazards that have been identified at this site include the following:

- Accidents caused by slipping, tripping, or falling
- Use of improper lifting techniques
- Moving or rotating equipment
- Equipment mobilization and operation (such as electrocution from contact with overhead or underground power lines)
- Improperly maintained equipment
- Improper use of heavy equipment

4.3 BIOHAZARDS

Biohazards may be encountered during site activities and present a potential threat to on-site personnel. Biohazards may include (1) contact with poisonous plants; (2) bites or stings from poisonous insects, such as the brown recluse spider, black widow spider, or scorpion; (3) bites from poisonous reptiles, such as the rattlesnake; and (4) bites or scratches from animals or contact with animal droppings. Site personnel should follow guidelines outlined in SWP 6-17, Biohazards (Appendix B), and the OSHO should discuss site-related biohazards and precautions during the daily tailgate meetings.

5.0 TRAINING REQUIREMENTS

All on-site personnel who may be exposed to hazardous conditions, including project team members and site visitors who will participate in on-site activities, will be required to meet training requirements outlined in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response." All personnel and visitors entering the site will be required to review this HASP and sign the Compliance Agreement form (HSP-4), and site workers will be required to attend a daily tailgate health and safety meeting and sign the Daily Tailgate Safety Meeting form (HST-2) (see Appendix A).

Before on-site activities begin, the OSHO will present a briefing for all personnel who will participate in on-site activities. The following topics will be addressed during the pre-work briefing:

- Names of the OSHO and the designated alternate
- Site history
- Work tasks
- Hazardous chemicals that may be encountered on site
- Physical hazards that may be encountered on site
- PPE, including type or types of respiratory protection to be used for work tasks
- Training requirements
- Environmental surveillance (air monitoring) equipment use and maintenance
- Action levels and situations requiring upgrade or downgrade of level of protection
- Site control measures, including site communications, control zones, and SWPs
- Decontamination procedures
- Emergency communication signals and codes
- Environmental accident emergency procedures (in case contamination spreads outside the exclusion zone)
- Personnel exposure and accident emergency procedures (in case of falls, exposure to hazardous substances, and other hazardous situations)
- Fire and explosion emergency procedures

- Emergency telephone numbers
- Emergency routes

Any other health and safety-related issues that may arise before on-site activities begin will also be discussed during the pre-work briefing.

Issues that arise during implementation of on-site activities will be addressed immediately. Changes to health and safety procedures will be discussed during subsequent tailgate safety meetings to be held daily before the workday or shift begins and will be documented in the Daily Tailgate Safety Meeting form (Form HST-2 in Appendix A).

6.0 PERSONAL PROTECTION REQUIREMENTS

The levels of personal protection to be used for work tasks at the TIMET site have been selected based on known or anticipated physical hazards; types and concentrations of contaminants that may be encountered on site; and contaminant properties, toxicity, exposure routes, and matrixes. The following sections describe protective equipment and clothing; reassessment of protection levels; limitations of protective clothing; and respirator selection, use, and maintenance.

6.1 PROTECTIVE EQUIPMENT AND CLOTHING

Personnel will wear protective equipment when (1) site activities involve known or suspected contamination; (2) site activities may generate vapors, gases, or particulates; or (3) direct contact with hazardous materials may occur. The anticipated levels of protection selected for use by field personnel during site activities are listed in Table 2, Task Hazard Analysis. Based on the anticipated hazard level, personnel will initially perform field tasks in Level D protection. If site conditions or the results of air monitoring performed during on-site activities warrant a higher level of protection, all field personnel will withdraw from the site, immediately notify the OSHO, and wait for further instructions. Equipment and clothing requirements for Level D, Level C, and Level B protection are provided below.

- Level D
  - Coveralls or work clothes

- Chemical-resistant clothing (such as Tyvek® or Saranex® coveralls)(as determined by the OSHO)
- Outer gloves (neoprene, nitrile, or other, as determined by the OSHO
- Disposable inner gloves (such as latex or vinyl) (as determined by the OSHO)
- Boots with steel-toe protection and steel shanks
- Disposable boot covers or chemical-resistant outer boots (as determined by the OSHO)
- Safety glasses or goggles
- Hard hat (face shield optional, as determined by the OSHO)
- Hearing protection (for areas with a noise level exceeding 85 decibels on the A-weighted scale)

• Level C

- Coveralls or work clothes
- Chemical-resistant clothing (such as Tyvek® or Saranex® coveralls)
- Outer gloves (neoprene, nitrile, or other, as determined by the OSHO)
- Disposable inner gloves (latex or vinyl)
- Boots with steel-toe protection and steel shanks
- Disposable boot covers or chemical-resistant outer boots
- Full- or half-face, air-purifying respirator with National Institute for Occupational Safety and Health (NIOSH)-approved cartridges to protect against organic vapors, dust, fumes, and mists (cartridges used for gas and vapors must be replaced in accordance with the change-out schedule described in the Respiratory Hazard Assessment form [Form RP-2] in Appendix C)
- Safety glasses or goggles (with a half-face respirator only)
- Hard hat (face shield optional, as determined by the OSHO)
- Hearing protection (for areas with a noise level exceeding 85 decibels on the A-weighted scale)

6.2 REASSESSMENT OF PROTECTION LEVELS

PPE levels shall be upgraded or downgraded based on a change in site conditions or investigation findings. When a significant change in site conditions occurs, hazards will be reassessed. Some indicators of the need for reassessment are as follows:

- Commencement of a new work phase, such as the start of a significantly different sampling activity or work that begins on a different portion of the site
- A change in job tasks during a work phase
- A change of season or weather
- Temperature extremes or individual medical considerations limiting the effectiveness of PPE
- Discovery of contaminants other than those previously identified
- A change in ambient levels of airborne contaminants (see the action levels listed in Table 3)
- A change in work scope that affects the degree of contact with contaminated media

6.3 LIMITATIONS OF PROTECTIVE CLOTHING

PPE clothing ensembles designated for use during site activities have been selected to provide protection against contaminants at known or anticipated on-site concentrations and physical states. However, no protective garment, glove, or boot is entirely chemical-resistant, nor does any protective clothing provide protection against all types of chemicals. Permeation of a given chemical through PPE depends on the contaminant concentration, environmental conditions, physical condition of the protective garment, and resistance of the garment to the specific contaminant. Chemical permeation may continue even after the source of contamination has been removed from the garment.

All site personnel will use the procedures presented below to obtain optimum performance from PPE.

- When chemical-protective coveralls become contaminated, don a new, clean garment after each rest break or at the beginning of each shift.
- Inspect all clothing, gloves, and boots both before and during use for the following:
  - Imperfect seams
  - Nonuniform coatings
  - Tears
  - Poorly functioning closures
- Inspect reusable garments, boots, and gloves both before and during use for visible signs of chemical permeation, such as the following:

- Swelling
- Discoloration
- Stiffness
- Brittleness
- Cracks
- Any sign of puncture
- Any sign of abrasion

Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above must be discarded. Reusable PPE will be decontaminated in accordance with procedures described in Section 10.0 and will be neatly stored in the support zone away from work zones.

6.4 RESPIRATOR SELECTION, USE, AND MAINTENANCE

Tetra Tech and subcontractor personnel will be informed of the proper use, maintenance, and limitations of respirators during annual health and safety refresher training and the pre-work briefing. Any on-site personnel who will use a tight-fitting respirator must pass a quantitative fit test for the respirator that follows the fit testing protocol provided in Appendix A of the OSHA respirator standard (29 CFR 1910.134). Quantitative fit testing must be repeated annually or when a new type of respirator is used.

Respirator selection is based on the assessment of the nature and extent of hazardous atmospheres anticipated during field activities. This assessment includes a reasonable estimate of employee exposure to respiratory hazards and identification of each contaminant's anticipated chemical form and physical state.

For each work task requiring respirator use at the TIMET site, a respiratory hazard assessment has been conducted. The results of this assessment are documented in the Respiratory Hazard Assessment form (Form RP-2), which has been approved by the HSR. The completed Form RP-2 is included in Appendix C and defines respiratory protection requirements for the project. Amendments to this HASP and to Form RP-2 will be discussed during daily tailgate safety meetings.

When the atmospheric contaminant is an identified gas or vapor and its concentration is known or can be reasonably estimated, respiratory protection options include the following:

- An atmosphere-supplying respirator (air-line or SCBA)
- An air-purifying respirator equipped with a NIOSH-certified, end-of-service-life indicator (ESLI) for the identified contaminant. If no ESLI is available, a change-out schedule for cartridges must be developed based on objective data or information. Respirator cartridge selection and change-out schedules will be evaluated by the HSR at the time of the respiratory hazard assessment. The Respiratory Hazard Assessment, Form RP-2, will describe the information and data used as the basis for the cartridge change-out schedule and the proposed change schedule.

For protection against particulate contaminants, approved respirators can include the following:

- An atmosphere supplying respirator
- A respirator equipped with a filter certified by NIOSH under 32 CFR Part 11 or 42 CFR Part 84 as a P100 filter (formerly known as a high-efficiency particulate [HEPA] air filter)

For any tasks performed in Level C PPE, a full- or half-face, air-purifying respirator equipped with NIOSH-approved cartridges or filters will be selected to protect against vapors, gases, and aerosols.

Air-purifying respirators will be used only in conjunction with breathing-space air monitoring, which must be conducted in adherence to the action levels outlined in Table 3. Air-purifying respirators will be used only when they can provide protection against the substances encountered on site.

Factors precluding use of Level C and air-purifying respirators are as follows:

- Oxygen-deficient atmosphere (less than 19.5 percent oxygen)
- Concentrations of substances that may be immediately dangerous to life and health
- Confined or unventilated areas that may contain airborne contaminants not yet characterized
- Unknown contaminant concentrations or concentrations that may exceed the maximum use levels for designated cartridges documented in the selected cartridge manufacturer's instructions
- Unidentified contaminants
- High relative humidity (more than 85 percent, which reduces the sorbent life of the cartridges)

- Respirator cartridges with an undetermined service life

Use, cleaning, and maintenance of respirators are described in SWP 6-27, Respirator Cleaning Procedures, and SWP 6-28, Safe Work Practices for Use of Respirators. These SWPs are included in Appendix B.

7.0 MEDICAL SURVEILLANCE

The following sections describe Tetra Tech's medical surveillance program, including health monitoring requirements, site-specific medical monitoring, and medical support and follow-up requirements. Procedures documented in these sections will be followed for all activities at the TIMET site. Additional requirements are defined in the Tetra Tech, Inc., "Health and Safety Manual." Note that this program may not be consistent with other project team member programs, but is required for all Tetra Tech employees.

7.1 HEALTH MONITORING REQUIREMENTS

All Tetra Tech and subcontractor personnel involved in on-site activities at the TIMET site must participate in a health monitoring program as required by 29 CFR 1910.120(f). Tetra Tech has established a health monitoring program with WorkCare, Inc., of Orange, California. Under this program, Tetra Tech personnel receive baseline and annual or biennial physical examinations consisting of the following:

- Complete medical and work history
- Physical examination
- Vision screening
- Audiometric screening
- Pulmonary function test
- Resting electrocardiogram
- Chest x-ray (required once every 3 years)
- Blood chemistry, including hematology and serum

- Urinalysis

For each employee, Tetra Tech receives a copy of the examining physician's written opinion after postexamination laboratory tests have been completed; the Tetra Tech employee also receives a copy of the written opinion. This opinion includes the following information (in accordance with 29 CFR 1910.120[f][7]):

- The results of the medical examination and tests
- The physician's opinion as to whether the employee has any medical conditions that would place the employee at an increased risk of health impairment from work involving hazardous waste operations or during an emergency response
- The physician's recommended limitations, if any, on the employee's assigned work; special emphasis is placed on fitness for duty, including the ability to wear any required PPE under conditions expected on site (for example, temperature extremes)
- A statement that the employee has been informed by the physician of the medical examination results and of any medical conditions that require further examination or treatment

All subcontractors must have health monitoring programs conducted by their own clinics in compliance with 29 CFR 1910.120(f). Any visitor or observer at the site will be required to provide records in compliance with 29 CFR 1910.120(f) before entering the site.

7.2 SITE-SPECIFIC MEDICAL MONITORING

There are no specific medical monitoring requirements for activities at the TIMET site.

7.3 MEDICAL SUPPORT AND FOLLOW-UP REQUIREMENTS

As a follow-up to an injury requiring care beyond basic first aid or to possible exposure above established exposure limits, all employees are entitled to and encouraged to seek medical attention and physical testing. Such injuries and exposures must be reported to the HSR. Depending on the type of injury or exposure, follow-up testing, if required, must be performed within 24 to 48 hours of the incident. It will be the responsibility of the employer's medical consultant to advise the type of test required to accurately monitor for exposure effects. The Accident and Illness Investigation Report (Form AR-1 in Appendix A) must be completed by the OSHO in the event of an accident, illness, or injury. A copy of this form must

be forwarded to the HSR for use in determining the recordability of the incident and for inclusion in Tetra Tech's medical surveillance records.

8.0 ENVIRONMENTAL MONITORING AND SAMPLING

Environmental monitoring or sampling will be conducted to assess personnel exposure levels as well as site or ambient conditions and to determine appropriate levels of PPE for work tasks. The following sections discuss initial and background air monitoring, personal monitoring, ambient air monitoring, monitoring parameters and devices, use and maintenance of survey equipment, thermal stress monitoring, and noise monitoring. Site-specific air monitoring requirements and action levels are provided in Table 3.

8.1 INITIAL AND BACKGROUND AIR MONITORING

Initial air monitoring of the work area will be performed before a work task begins. This monitoring will be performed using real-time field survey instrumentation. Air will also be monitored at the beginning of each workday to identify any potentially hazardous situation that might have developed during off-shift periods.

Operations at the site may result in variable background levels of airborne compounds. Airborne compounds may be released from vehicles, blowing dust, material transfers, and so on. These sources can complicate evaluation of contaminant emissions during project tasks. Therefore, several upwind and pre-work measurements will be taken to assess contributions to airborne contamination by other potential sources.

8.2 PERSONAL MONITORING

The employees working closest to a source of contamination have the highest likelihood of exposure to airborne contaminant concentrations that may exceed established exposure limits. Therefore, selective monitoring of the workers who are closest to a source of contaminant generation will be conducted

TABLE 3

SITE-SPECIFIC AIR MONITORING REQUIREMENTS AND ACTION LEVELS
TITANIUM METALS CORPORATION FACILITY, HENDERSON, NEVADA

Contaminant or Hazard	Task	Monitoring Device	Action Level	Monitoring Frequency	Action[a]
Organic vapors	Monitoring well installation, development, and sampling	FID and/or PID	BG to 5 ppm above BG	At the beginning of the task and every 30 to 60 minutes during the task	Use Level D PPE
	Stratigraphic boring installation		5 to 100 ppm above BG	Every 30 minutes	Use Level C PPE (unless specific chemicals are identified and evaluated using detector tube)
	Aquifer testing		> 100 ppm above BG	Not applicable	Stop work, evacuate area; notify OSHO and evaluate source
Combustible atmosphere	Soil boring or other invasive work at or near the landfill where landfill gases may pose exposition risk	CGI	<10% LEL	Continuous	Continue work
			10 to 25% LEL		Continue work with extreme caution
			>25% LEL		Stop work, evacuate area; notify OSHO and evaluate source
Oxygen-deficient or enriched atmosphere	None	Oxygen meter	19.5 to 23.5%	Continuous	Continue work
			<19.5% or >23.5%		Stop work, evacuate area; notify OSHO and evaluate source

TABLE 3 (Continued)

SITE-SPECIFIC AIR MONITORING REQUIREMENTS AND ACTION LEVELS
TITANIUM METALS CORPORATION FACILITY, HENDERSON, NEVADA

Contaminant or Hazard	Task	Monitoring Device	Action Level	Monitoring Frequency	Action[a]
External exposure to radiation	All environmental investigation activities	Radiation meter	Normal BG (Equipment must be calibrated in an area known to be free of radiation hazards)	Continuous or as needed	Continue work and monitoring when working in new areas
			Two to three times BG	Continuous	Notify SSC and proceed with caution
			Higher than three times BG	Not applicable	Stop work, evacuate area; notify OSHO and evaluate source
Particulates	All environmental investigation activities	Miniram PDM-3 particulate monitor	BG to 5 mg/m^3 above BG (BG to 0.25 mg/m^3 above BG if radionuclides are present)	Hourly or more frequent, as determined by SSC	Use Level D PPE
			5 to 10 mg/m^3 above BG (> 0.25 mg/m^3 above BG if radionuclides are present)	Continuous	Use Level C PPE and implement dust suppression activities
			>10 mg/m^3 above BG	Not applicable	Stop work and implement dust suppression activities; notify OHSO
Noise	All environmental investigation activities	Sound level meter or rule of thumb test[b]	∃85 dBA	When necessary	Use hearing protection

TABLE 3 (Continued)

SITE-SPECIFIC AIR MONITORING REQUIREMENTS AND ACTION LEVELS
TITANIUM METALS CORPORATION FACILITY, HENDERSON, NEVADA

Notes:

APR	Air-purifying respirator
BG	Background
CGI	Combustible gas indicator
dBA	Decibel as measured on the A-weighted scale
FID	Flame ionization detector
LEL	Lower explosive limit
mg/m^3	Milligram per cubic meter
OSHO	On-site Health and Safety Officer
PEL	Permissible exposure limit
PID	Photoionization detector
PPE	Personal protective equipment
ppm	Part per million
VOC	Volatile organic compound

[a] Refer to Table 2 for specific types of gloves, chemical resistant clothing, respirators, and cartridges.
[b] Rule of thumb is inability to hear and understand conversation in normal speaking level when three feet away from person who is speaking.

during site activities. Personal monitoring shall be conducted in the breathing zone and, if a worker is wearing respiratory protective equipment, outside the face piece.

8.3 AMBIENT AIR MONITORING

Most tasks will require monitoring of the general work area or ambient site conditions. Ambient monitoring will generally be conducted using direct-reading survey instrumentation or compound-specific instruments or detector tubes.

Initial ambient air monitoring will be performed as a minimum requirement when any of the situations listed below arise.

- Work begins on a different portion of the site.
- Contaminants other than those previously identified are encountered.
- A different type of operation is initiated (for example, well installation is initiated after drilling activities).
- Workers handle leaking containers or work in areas with obvious liquid contamination (for example, spill or lagoon areas).
- Obvious lithologic changes are noticed during drilling activities.
- Workers experience physical difficulties.

Periodic ambient air monitoring will be performed at the frequency listed in Table 3.

8.4 MONITORING PARAMETERS AND DEVICES

The following sections below briefly describe the use and limitations of instruments used to monitor for organic vapors, combustible atmospheres, percent oxygen, external exposure to radiation, and particulates. Site-specific air monitoring requirements and action levels are listed in Table 3.

All monitors will be calibrated in accordance with manufacturer recommendations at the beginning of every workday, if possible. Calibration results along with air monitoring data will be recorded in the field logbook.

8.4.1 Organic Vapors

A direct-reading organic vapor monitor, such as a flame ionization detector (FID) or photoionization detector (PID), will be used to determine the presence of volatile organic compounds (VOC). Table 3 specifies the instrument that will be used for the project. The concentrations of individual VOCs of concern cannot usually be determined using the instrument because the detector responds to the total VOC mixture.

8.4.2 Combustible Atmospheres

A direct-reading combustion gas indicator instrument will be used to measure potential explosive environments during invasive activities at or near the landfill; where combustible landfill gases may be present. Table 3 specifies the instrument, criteria for evaluating the potential hazard, and actions to be taken.

8.4.3 Percent Oxygen

Percent oxygen is not considered an issue and will not be monitored during any of the site activities.

8.4.4 External Exposure to Radiation

If the potential for external exposure to radiation exists, it is recommended that all personnel be required to wear radiation exposure monitoring devices while working on site. Personal exposure monitoring devices may include a thermoluminescence detector (TLD), a standard film badge, or a pocket dosimeter. Monitoring devices are to be left at the site at the end of each working day in a location removed from any source material. An outside vendor will supply the TLDs, badges, or dosimeters and will perform laboratory analyses on TLDs and film badges. The external radiation exposure limit for site personnel will be 1.25 Roentgen-equivalent man units (rem) per 3 months with a 5-rem maximum per year (National Council on Radiation Protection and Measurements 1993).

If necessary, radiation detectors will be used to determine the types and levels of radiation present. Appropriate instrumentation, such as alpha or gamma meters and Geiger counters, will be used. The monitoring device, monitoring frequency, and action levels for external exposure to radiation during site activities are listed in Table 3.

8.4.5 Particulates

Aerosols are a group of airborne materials that include particulates, fumes, mists, and smoke. Particulates are the primary aerosol of concern at hazardous waste sites. If climatic conditions, surface soil conditions, or site operations (such as excavation activities) adversely impact ambient air quality by increasing particulate matter for extended periods of time, air monitoring using a direct-reading instrument for particulates may become necessary. If elevated (visible) particulate matter conditions persist for 5 minutes or longer, the OSHO is responsible for sampling the breathing zone with a particulate monitor.

Generally, particulate monitors are capable of measuring both solid and liquid particulates within the size range of 0.1 to 10 micrometers (the respirable range). A monitor indicates the concentration of these particulates in units of milligrams per cubic meter of air.

Action levels for particulates will be based on the type of dust and hazardous materials that may contribute to the composition of the particulates and will be determined with the assistance of the HSR or designee. Table 3 lists the monitoring device, monitoring frequency, and general action levels expected to be used during site activities.

8.5 USE AND MAINTENANCE OF SURVEY EQUIPMENT

All personnel using field survey equipment must have training in its operation, limitations, and maintenance. Maintenance and internal or electronic calibration will be performed in accordance with manufacturer recommendations by individuals familiar with the devices before their use on site. Repairs, maintenance, and internal or electronic calibration of these devices will be recorded in an equipment maintenance logbook. The equipment maintenance logbook for each instrument will be kept in that instrument's case. For rented monitoring equipment, repairs and maintenance will be conducted by the rental company. Results of routine calibration will be recorded in the field logbook.

Air monitoring equipment (such as combustible gas indicators, oxygen meters, and PIDs) will be calibrated before work begins as directed by manufacturer instructions. Only basic maintenance (such as changing batteries) will be performed by on-site personnel. Any additional maintenance or repairs will be performed by a trained service technician.

8.6 THERMAL STRESS MONITORING

Heat stress and cold stress are common and serious threats at hazardous waste sites. SWPs 6-15 and 6-16 discuss heat and cold stress, respectively, and include monitoring methods appropriate for the season and location of work (see Appendix B).

8.7 NOISE MONITORING

In most cases, high noise levels at a work site are caused by heavy equipment, such as drill rigs and backhoes, or sources associated with the work site, such as factory equipment and vehicles. When noise levels at the TIMET site are suspected to equal or exceed an 8-hour time-weighted average (TWA) of 85 decibels on an A-weighted scale in slow response mode (85 dBA), the OSHO will evaluate the work area to characterize the noise source and exposure levels. A sound level meter may be used for the evaluation but a noise dosimeter is recommended for documenting full-shift noise exposures. If neither instrument is available, the OSHO may use a simple rule-of-thumb test to determine whether noise levels exceed 85 dBA. The test requires the OSHO to determine how loud he or she must speak to be heard at an arm's length from another person. If the OSHO must raise his or her voice to be heard, the average noise level likely exceeds 85 dBA.

If employees are exposed to noise levels that exceed the action level of 85 dBA, hearing protection must be worn. The protectors will be ear plugs or muffs that must provide sufficient attenuation to limit noise exposure to less than 85 dBA. The OSHO will supervise use of hearing protectors at the work site as necessary. Table 3 lists the monitoring device and action levels to be used.

9.0 SITE CONTROL

Site control is an essential component in HASP implementation. The following sections discuss measures and procedures for site control, such as on-site communications, site control zones, site access control, site safety inspections, and SWPs.

9.1 ON-SITE COMMUNICATIONS

Successful communication between field teams and personnel in the support zone is essential. The following communication systems will be available during site activities:

- Cellular telephones
- Two-way radios
- Compressed air horn
- Megaphone
- Whistle

The hand signals listed below will be used by site personnel in emergency situations or when verbal communication is difficult.

Signal	Definition
Hands clutching throat	Out of air or cannot breathe
Hands on top of head	Need assistance
Thumbs up	Okay, I am all right, or I understand
Thumbs down	No or negative
Arms waving upright	Send backup support
Gripping partner's wrist	Exit area immediately

9.2 SITE CONTROL ZONES

To control the spread of contamination and employee exposures to chemical and physical hazards, on-site work areas may be divided into an exclusion zone, a decontamination zone, and a support zone. Access to the exclusion and decontamination zones will be restricted to authorized personnel. Any visitors to these areas must present proper identification and be authorized to be on site. The OSHO will identify work areas that visitors or personnel are authorized to enter and will enforce site control measures.

The following sections describe the exclusion zone, the decontamination zone, and the support zone as well as procedures to be followed in each.

9.2.1 Zone 1: Exclusion Zone

An exclusion zone includes areas where contamination is either known or likely to be present or, because of work activity, has the potential to cause harm to personnel. The perimeter of the exclusion zone and an

appropriate radius around work task areas will be demarcated by a physical barrier, such as barricade tape or traffic cones, to restrict access. A daily roster with the date of each person's entrance into the exclusion zone; the person's name, signature, and organization; and the time of entry and exit will be kept for all personnel working in the zone. Visitors will not be permitted to enter the exclusion zone without proper qualifications, equipment, and OSHO authorization. Work tasks that may require establishment of an exclusion zone include the following:

- Install stratigraphic borings and groundwater monitoring wells using direct push, hollow-stem auger, and mud rotary technologies
- Sample soil and groundwater, to include measurement of water levels in wells
- Conduct aquifer testing

9.2.2 Zone 2: Decontamination Zone

A decontamination zone is required for the TIMET site. The decontamination zone will contain facilities to decontaminate personnel and portable equipment. A steam-cleaning area for decontamination of heavy equipment and vehicles may be established at a location readily accessible from work areas. Equipment decontamination procedures are described in Section 10.0. Visitors will not be permitted to enter the decontamination zone without proper qualifications and OSHO authorization.

9.2.3 Zone 3: Support Zone

A support zone may consist of any uncontaminated and nonhazardous part of the site. The support zone should be situated in an area generally upwind of any exclusion zone whenever possible. Site visitors not meeting training, medical surveillance, and PPE requirements must stay in the support zone.

9.3 SITE ACCESS CONTROL

The study area at the TIMET site is bounded by the Las Vegas Wash to the north, Lake Mead Drive to the east and south, and the remainder of the BMI Industrial Complex to the west. Access to the site is controlled by fencing, security gates, sign-in points, and other control features as appropriate.

9.4 SITE SAFETY INSPECTIONS

Periodic site safety inspections shall be conducted by the OSHO to ensure safe work areas and compliance with this HASP. Results of the site safety inspections will be recorded in the field logbook or on a Field Audit Checklist (Form AF-1 in Appendix A).

9.5 SAFE WORK PRACTICES

Various SWPs are applicable to the TIMET site. These SWPs are included in Appendix B to this HASP. The following SWPs apply to the site:

- SWP 6-1, General Safe Work Practices
- SWP 6-2, Control of Hazardous Energy Sources
- SWP 6-3, Safe Drilling Practices
- SWP 6-4, Excavation Practices
- SWP 6-5, Working Over or Near Water
- SWP 6-9, Fall Protection Practices
- SWP 6-10, Portable Ladder Safety
- SWP 6-11, Drum and Container Handling Practices for Drummed IDW
- SWP 6-12, Shipping Dangerous Goods
- SWP 6-13, Flammable Hazards and Ignition Sources
- SWP 6-14, Spill and Discharge Control Practices
- SWP 6-15, Heat Stress
- SWP 6-16, Cold Stress
- SWP 6-17, Biohazards
- SWP 6-21, Radiation Safety Practices
- SWP 6-26, Use of Heavy Equipment
- SWP 6-27, Respirator Cleaning Procedures

- SWP 6-28, Safe Work Practices for Use of Respirators

10.0 DECONTAMINATION

Decontamination is the process of removing or neutralizing contaminants on personnel or equipment. When properly conducted, decontamination procedures protect workers from contaminants that may have accumulated on PPE, tools, and other equipment. Proper decontamination also prevents transport of potentially harmful materials to uncontaminated areas. Personnel and equipment decontamination procedures are described in the following sections.

10.1 PERSONNEL DECONTAMINATION

Personnel decontamination at the site will be limited by using disposable PPE whenever possible. Any personnel decontamination procedures will follow guidance in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH and others 1985). Personnel and PPE will be decontaminated with potable water or a mixture of detergent and water. Liquid and solid wastes generated during decontamination will be collected and drummed.

The decontamination procedures listed below will be conducted if personnel decontamination is required.

- Wash neoprene boots or disposable booties with a Liquinox® or Alconox® solution, and rinse them with water. Remove and retain neoprene boots for reuse, if possible. Place disposable booties in plastic bags for disposal.
- Wash outer gloves in a Liquinox® or Alconox® solution, and rinse them in water. Remove outer gloves and place them in a plastic bag for disposal.
- Remove chemical-resistant clothing, and place it in a plastic bag for disposal.
- Remove the air-purifying respirator, if used, and place the spent filter in a plastic bag for disposal. The filter must be changed in accordance with the Respiratory Hazard Assessment form (Form RP-2 in Appendix C). Clean and disinfect the respirator in accordance with SWP 6-27, and place it in a plastic bag for storage.
- Remove inner gloves and place them in a plastic bag for disposal.
- Thoroughly wash the hands and face with water and soap.

Used, disposable PPE will be collected in sealable containers and will be disposed of in accordance with procedures described in the Sampling and Analysis Plan. Personnel decontamination procedures may be modified as necessary while on site.

10.2 EQUIPMENT DECONTAMINATION

Decontamination of all drilling, sampling, and field monitoring equipment used during site activities will be required. Decontamination of on-site heavy equipment and sampling equipment will follow procedures defined in the site's Sampling and Analysis Plan. Equipment decontamination procedures described in the following sections are based on guidelines appropriate for low-level contamination. Additional procedures may be found in EPA SOP No. 2006, titled "Sampling Equipment Decontamination" dated August 11, 1994. Wastewater from equipment decontamination activities will be stored in 55-gallon drums prior to characterization and proper disposal.

10.2.1 Heavy Equipment

Heavy equipment, such as drilling and excavating vehicles, will be decontaminated at a designated location in the decontamination zone. Gross decontamination will be performed using a cleaning brush to loosen debris, and steam-cleaning with a high-pressure steam spray. If equipment still has soil on it after steam-cleaning, an appropriate cleaning brush will be used to further loosen debris, and the equipment will be steam-cleaned again. All wastewater generated from decontamination activities will be collected and stored in 55-gallon drums until proper disposal is arranged.

10.2.2 Sampling Equipment

Sampling equipment, such as split spoons, will be decontaminated before and after each use as described below.

- Scrub the equipment with a brush in a bucket containing Liquinox® or Alconox® solution and distilled water.
- Triple-rinse the equipment with distilled water, and allow it to air-dry.
- Reassemble the equipment, and place it on plastic or aluminum foil in a clean area. If aluminum foil is used, wrap the equipment with the dull side of the aluminum foil toward the equipment.

10.2.3 Field Monitoring Equipment

Field monitoring equipment, such as the Miniram dust monitor, radiation meter, PID, and/or FID, may become contaminated during use in the exclusion zone. Contamination will be removed by carefully wet wiping and drying the equipment with paper towels. Waste will be disposed of on site. To minimize contamination of field monitoring equipment, equipment should be covered with plastic before use.

11.0 EMERGENCY RESPONSE PLANNING

This section describes emergency response planning procedures to be implemented for the site. This section is consistent with local, state, and federal disaster and emergency management plans. The following sections discuss pre-emergency planning, personnel roles and lines of authority, emergency recognition and prevention, evacuation routes and procedures, emergency contacts and notifications, hospital route directions, emergency medical treatment procedures, protective equipment failure, fire or explosion, weather-related emergencies, spills or leaks, emergency equipment and facilities, and reporting.

11.1 PRE-EMERGENCY PLANNING

During the pre-work briefing and daily tailgate safety meetings, all on-site employees will be trained in and reminded of the provisions of Section 11.0, site communication systems, and site evacuation routes. The emergency response provisions will be reviewed on a regular basis by the OSHO and will be revised, if necessary, to ensure that they are adequate and consistent with prevailing site conditions.

11.2 PERSONNEL ROLES AND LINES OF AUTHORITY

The OSHO has primary responsibility for responding to and correcting emergency situations and for taking appropriate measures to ensure the safety of site personnel and the public. Possible actions may include evacuation of personnel from the site area. The OSHO is also responsible for ensuring that corrective measures have been implemented, appropriate authorities have been notified, and follow-up reports have been completed.

Individual subcontractors are required to cooperate with the OSHO, within the parameters of their scopes of work.

Personnel are required to report all injuries, illnesses, spills, fires, and property damage to the OSHO. The OSHO must be notified of any on-site emergencies and is responsible for ensuring that the appropriate emergency procedures described in this section are followed. The local fire or emergency response department will be supplied with a copy of this HASP before site work begins.

11.3 EMERGENCY RECOGNITION AND PREVENTION

Table 1 lists potential on-site chemical hazards, and Table 2 provides information on the hazards associated with the different tasks planned for the site. On-site personnel will be made familiar with this information and with techniques of hazard recognition through pre-work training and site-specific briefings.

11.4 EVACUATION ROUTES AND PROCEDURES

In the event of an emergency that necessitates evacuation of a work task area or the site, the OSHO shall contact all nearby personnel using the on-site communications discussed in Section 9.1 to advise the personnel of the emergency. The personnel will proceed along site roads to a safe distance upwind from the hazard source. The personnel will remain in that area until the OSHO or an authorized individual provides further instructions.

11.5 EMERGENCY CONTACTS AND NOTIFICATIONS

The emergency information before Section 1.0 of this HASP provides names and telephone numbers of emergency contact personnel. THIS PAGE MUST BE POSTED ON SITE OR MUST BE READILY AVAILABLE AT ALL TIMES. In the event of a medical emergency, personnel will notify the appropriate emergency organization and will take direction from the OSHO. In the event of a fire, explosion, or spill at the site, the OSHO will notify the appropriate local, state, and federal agencies and will follow procedures discussed in Section 11.9 or 11.11.

11.6 HOSPITAL ROUTE DIRECTIONS

Before performing any site activities, Tetra Tech personnel will conduct a pre-emergency hospital run to familiarize themselves with the route to the local hospital. A map showing the hospital route is provided in the emergency information before Section 1.0 of this HASP.

11.7 EMERGENCY MEDICAL TREATMENT PROCEDURES

A person who becomes ill or injured during work tasks may require decontamination. If the illness or injury is minor, any decontamination necessary will be completed and first aid should be administered prior to patient transport. If the patient's condition is serious, partial decontamination will be completed (such as complete disrobing of the person and redressing in the person in clean coveralls or wrapping in a blanket). First aid should be administered until an ambulance or paramedics arrive. All injuries and illnesses must be reported immediately to the Tetra Tech project manager and HSR.

Any person transported to a clinic or hospital for chemical exposure treatment will be accompanied by information on the chemical he or she has been exposed to at the site, if possible. Table 1 contains this information.

11.8 PROTECTIVE EQUIPMENT FAILURE

If any worker in the exclusion zone experiences a failure of protective equipment (either engineering controls or PPE) that affects his or her personal protection, the worker and all coworkers will immediately leave the exclusion zone. Re-entry to the exclusion zone will not be permitted until (1) the protective equipment has been repaired or replaced, (2) the cause of the equipment failure has been determined, and (3) the equipment failure is no longer considered to be a threat.

11.9 FIRE OR EXPLOSION

In the event of a fire or explosion on site, the local fire department will be immediately summoned. The OSHO or a site representative will advise the fire department of the location and nature of any hazardous materials involved. Appropriate provisions of Section 11.0 will be implemented by site personnel.

11.10 WEATHER-RELATED EMERGENCIES

Site work shall not be conducted during severe weather conditions, including high-speed winds or lightning. In the event of severe weather, field personnel will stop work, secure and lower all equipment (for example, drilling masts), and leave the site.

Thermal stress caused by excessive heat or cold may occur as a result of extreme temperatures, workload, or the PPE used. Heat and cold stress treatment will be administered as described in SWPs 6-15 and 6-16, respectively.

11.11 SPILLS OR LEAKS

In the event of a severe spill or a leak, site personnel will follow the procedures listed below.

- Evacuate the affected area and relocate personnel to an upwind location.
- Inform the OSHO, Tetra Tech project manager, the applicable Tetra Tech office (if Tetra Tech personnel were involved), and a site representative immediately.
- Locate the source of the spill or leak, and stop the flow if it is safe to do so.
- Begin containment and recovery of spilled or leaked materials.
- Notify appropriate local, state, and federal agencies.

Additional information on spill and leak control is presented in SWP 6-14.

11.12 EMERGENCY EQUIPMENT AND FACILITIES

The following emergency equipment will be available on site:

- First aid kit
- Eye wash (portable)
- Fire extinguisher
- Two-way radio
- Site telephone
- Mobile telephone
- Sorbent material
- Drums
- Spill kits

- Berm material

11.13 REPORTING

All emergency situations require follow-up and reporting. Appendix A includes the Tetra Tech Accident and Illness Investigation Report (Form AR-1). This report must be completed and submitted to the Tetra Tech project manager within 24 hours of an emergency situation. The project manager will review the report and then forward it to the Tetra Tech HSR for review. The report must include proposed actions to prevent similar incidents from occurring. The HSR must be fully informed of the corrective action process so that she may implement applicable elements of the process at other sites.

12.0 REFERENCES

American Conference of Governmental Industrial Hygienists. 2006. *Threshold Limit Values and Biological Exposure Indices*.

National Council on Radiation Protection and Measurements. 1993. *Limitation of Exposure to Ionizing Radiation*. Report No. 116.

National Institute for Occupational Safety and Health (NIOSH) and others. 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. October.

NIOSH. 2005. "Pocket Guide to Chemical Hazards." U.S. Department of Health and Human Services. U.S. Government Printing Office. Washington, DC. September.

Tetra Tech EM Inc. 2004a. "Preliminary Conceptual Site Model, Accelerated Work, Titanium Metals Corporation Facility, Henderson, Nevada." June 24.

Tetra Tech EM Inc. 2004b. "Semiannual Groundwater Monitoring Report, 2nd Quarter 2004, Titanium Metals Corporation Facility, Henderson, Nevada." July 30.

Tetra Tech, Inc. 1999. "Health and Safety Manual."

APPENDIX A

TETRA TECH FORMS

- Compliance Agreement (Form HSP-4)
- Daily Tailgate Safety Meeting (Form HST-2)
- Daily Site Log (Form SSC-1)
- Accident and Illness Investigation Report (Form AR-1)
- Field Audit Checklist (Form AF-1)

TETRA TECH, INC.

HEALTH AND SAFETY PLAN COMPLIANCE AGREEMENT

Project Name: _____

Project Number: _____

I have read and understand the health and safety plan indicated above and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Name	Signature	Employer	Date

TETRA TECH, INC.

DAILY TAILGATE SAFETY MEETING FORM

Date: _____ Time: _____ Project No.: _____

Client: _____ Site Location: _____

Site Activities Planned for Today: _____

_____

Safety Topics Discussed
Protective clothing and equipment:
Chemical hazards:
Physical hazards:
Environmental and biohazards:
Equipment hazards:
Decontamination procedures:
Other:
Review of emergency procedures:
Employee Questions or Comments:

TETRA TECH, INC.

DAILY TAILGATE SAFETY MEETING FORM (Continued)

Attendees	
Printed Name	**Signature**

Meeting Conducted by:

_____ _____

Name Title

_____

Signature

TETRA TECH, INC.

DAILY SITE LOG

Site Name: _____ Date: _____

Name (print)	Company	Time	
		In	Out

Comments:

_____

_____

_____

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT

To: _____
Subsidiary Health and Safety Representative

Cc: _____
Workers Compensation Administrator

Project name: MDI Superfund Site, Houston, TX

Project number: G00DA110703

Prepared by: _____

Position: _____

Office: _____

Telephone number: _____

Fax number: _____

Information Regarding Injured or Ill Employee

Name: _____

Office: _____

Home address: _____

_____

Gender: M ☐ F ☐ No. of dependents: _____

Marital status: _____

Home telephone number: _____

Date of birth: _____

Occupation (regular job title): _____

Social Security Number: _____

Department: _____

Date of Accident: _____

Time Employee Began Work: _____

Time of Accident: _____ a.m. ☐ p.m. ☐

☐ Check if time cannot be determined

Location of Accident

Street address: _____

City, state, and zip code: _____

County: _____

Was place of accident or exposure on employer's premises? Yes ☐ No ☐

Information About the Case

What was the employee doing just before the incident occurred?: Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. Examples: "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."

What Happened?: Describe how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."

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

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Information About the Case (Continued)

What was the injury or illness? Describe the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or "sore." Examples "strained back"; "chemical burn, right hand"; "carpal tunnel syndrome, left wrist."

Describe the Object or Substance which Directly Harmed the Employee: Examples: "concrete floor"; "chlorine"; "radial arm saw." If this question does not apply to the incident, enter a NA.

Did the employee die? Yes ☐ No ☐ Date of death: _____

Was employee performing regular job duties? Yes ☐ No ☐

Was safety equipment provided? Yes ☐ No ☐ Was safety equipment used? Yes ☐ No ☐

Note: Attach any police reports or related diagrams to this accident report.

Witness(es):

Name: _____

Company: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Name: _____

Company: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Medical Treatment Required? ☐ Yes ☐ No ☐ First Aid only

Name of physician or health care professional: _____

If treatment was provided away from the work-site, where was it given?

Facility name: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Was the employee treated in an emergency room? ☐ Yes ☐ No

Was the employee hospitalized overnight as an in-patient? ☐ Yes ☐ No

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

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Corrective Action(s) Taken by Unit Reporting the Accident:

Corrective Action Still to be Taken (by whom and when):

Name of Tetra Tech employee the injury or illness was first reported to: _____

Date of Report: _____ **Time of Report:** _____

I have reviewed this investigation report and agree, to the best of my recollection, with its contents.

_____ _____

Printed Name of Injured Employee Telephone Number

_____ _____

Signature of Injured Employee Datee

The signatures provided below indicate that appropriate personnel have been notified of the incident.

Title	Printed Name	Signature	Telephone Number	Date
Project or Office Manager				
Site Safety Coordinator				

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

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

To be completed by the Subsidiary Safety and Health Representative:

Classification of Incident:

☐ Injury ☐ Illness

Result of Incident:

☐ First Aid Only

☐ Days Away From Work

☐ Remained at Work but Incident Resulted in Job Transfer or Work Restriction

☐ Incident Involved Days Away and Job Transfer or Work Restriction

☐ Medical Treatment Only

No. of Days Away From Work _____

Date Employee Left Work _____

Date Employee Returned to Work _____

No. of Days Placed on Restriction or Job Transfer: _____

OSHA Recordable Case Number _____

To be completed by Human Resources:

SSN: _____

Date of hire: _____ Hire date in current job: _____

Wage information: $ _____ per ☐ Hour ☐ Day ☐ Week ☐ Month

Position at time of hire: _____

Current position: _____ Shift hours: _____

State in which employee was hired: _____

Status: ☐ Full-time ☐ Part-time Hours per week: _____ Days per week: _____

Temporary job end date: _____

To be completed during report to workers' compensation carrier:

Date reported: _____ Reported by: _____

Confirmation number: _____

Name of contact: _____

Field office of claims adjuster: _____

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

TETRA TECH, INC.

FIELD AUDIT CHECKLIST

Project Name: _____ Project No.: _____

Field Location: _____ Completed by: _____

Project Manager: _____ Site Safety Coordinator: _____

General Items		In Compliance?		
Health and Safety Plan Requirements		Yes	No	NA
1	Approved health and safety plan (HASP) on site or available			
2	Names of on-site personnel recorded in field logbook or daily log			
3	HASP compliance agreement form signed by all on-site personnel			
4	Material Safety Data Sheets on site or available			
5	Designated site safety coordinator present			
6	Daily tailgate safety meetings conducted and documented			
7	On-site personnel meet HASP requirements for medical examinations, fit testing, and training (including subcontractors)			
8	Compliance with specified safe work practices			
9	Documentation of training, medical examinations, and fit tests available from employer			
10	Exclusion, decontamination, and support zones delineated and enforced			
11	Windsock or ribbons in place to indicate wind direction			
12	Illness and injury prevention program reports completed (California only)			
Emergency Planning				
13	Emergency telephone numbers posted			
14	Emergency route to hospital posted			
15	Local emergency providers notified of site activities			
16	Adequate safety equipment inventory available			
17	First aid provider and supplies available			
18	Eyewash stations in place			
Air Monitoring				
19	Monitoring equipment specified in HASP available and in working order			
20	Monitoring equipment calibrated and calibration records available			
21	Personnel know how to operate monitoring equipment and equipment manuals available on site			
23	Environmental and personnel monitoring performed as specified in HASP			

TETRA TECH, INC.

FIELD AUDIT CHECKLIST (Continued)

Safety Items		In Compliance?		
Personal Protection		Yes	No	NA
1	Splash suit			
2	Chemical protective clothing			
3	Safety glasses or goggles			
4	Gloves			
5	Overboots			
6	Hard hat			
7	Dust mask			
8	Hearing protection			
9	Respirator			
Instrumentation				
10	Combustible gas meter			
11	Oxygen meter			
12	Organic vapor analyzer			
Supplies				
13	Decontamination equipment and supplies			
14	Fire extinguishers			
15	Spill cleanup supplies			
Corrective Action Taken During Audit:				
Corrective Action Still Needed:				

Note: NA = Not applicable

Auditor's Signature

Site Safety Coordinator's Signature

Date

APPENDIX B

SAFE WORK PRACTICES

- SWP 6-1 General Safe Work Practices
- SWP 6-2 Control of Hazardous Energy Sources (Lockout/Tagout)
- SWP 6-3 Safe Drilling Practices
- SWP 6-4 Excavation Practices
- SWP 6-5 Working Over or Near Water
- SWP 6-9 Fall Protection Practices
- SWP 6-10 Portable Ladder Safety
- SWP 6-11 Drum and Container Handling Practices
- SWP 6-12 Shipping Dangerous Goods
- SWP 6-13 Flammable Hazards and Ignition Sources
- SWP 6-14 Spill and Discharge Control Practices
- SWP 6-15 Heat Stress
- SWP 6-16 Cold Stress
- SWP 6-17 Biohazards
- SWP 6-21 Radiation Safety Practices
- SWP 6-26 Use of Heavy Equipment
- SWP 6-27 Respirator Cleaning Procedures
- SWP 6-28 Safe Work Practices for Use of Respirators

TETRA TECH, INC.
HEALTH AND SAFETY MANUAL
VOLUME III

SAFE WORK PRACTICES (SWP)

GENERAL SAFE WORK PRACTICES

SWP NO.: 6-1

ISSUE DATE: JULY 1998

REVISION NO.: 1

Disclaimer: This safe work practice (SWP) is the property of Tetra Tech, Inc. (Tetra Tech), and its subsidiaries. Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

GENERAL SAFE WORK PRACTICES

To prevent injuries and adverse health effects, the following general safe work practices (SWP) are to be followed when conducting work involving known and unknown site hazards. These SWPs establish a pattern of general precautions and measures for reducing risks associated with hazardous site operations. This list is not inclusive and may be amended as necessary.

- Do not eat, drink, chew gum or tobacco, take medication, or smoke in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible if excessive skin contamination occurs.
- Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on drums, equipment, or the ground. Do not place monitoring equipment on potentially contaminated surfaces.
- Remove beards or facial hair that interfere with a satisfactory qualitative respirator fit test or routine pre-entry positive and negative pressure checks.
- Be familiar with and knowledgeable of and adhere to all instructions in the site-specific health and safety plan (HASP). At a minimum, a safety meeting will be held at the start of each project to discuss the HASP. Additional meetings will be held, as necessary, to address new or continuing safety and health concerns.
- Be aware of the location of the nearest telephone and all emergency telephone numbers.
- Attend a briefing on the anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and delineate entrance, exit, and emergency escape routes.
- Rehearse unfamiliar operations prior to implementation.
- Use the “buddy system” whenever respiratory protection equipment is in use. Buddies should establish hand signals or other means of emergency communication in case radios break down or are unavailable.
- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity in order to assist each other in case of emergency.

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- Minimize the number of personnel and equipment in contaminated areas (such as the exclusion zone). Nonessential vehicles and equipment should remain within the support zone.

- Establish appropriate support, contamination reduction, and exclusion zones.

- Establish appropriate decontamination procedures for leaving the site.

- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the site safety coordinator (SSC).

- Maintain a portion of the site field logbook as a project safety log. The project safety log will be used to record the names, entry and exit dates, and times on site of all Tetra Tech, subcontractor, and project site visitor personnel; air quality and personal exposure monitoring data; and other information related to safety matters. Form SSC-1, Daily Site Log, may be used to record names of on-site personnel.

- A portable eyewash station should be located in the support zone if chemical splashes to eyes are possible.

- Do not bring matches and lighters in the exclusion zone or contamination reduction zone.

- Observe coworkers for signs of toxic exposure and heat or cold stress.

- Inform coworkers of nonvisual effects of illness if you experience them, such as headaches, dizziness, nausea, or blurred vision.

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TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

CONTROL OF HAZARDOUS ENERGY SOURCES (LOCKOUT/TAGOUT)

SWP NO.: 6-2

ISSUE DATE: JULY 1998

REVISION NO.: 1

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CONTROL OF HAZARDOUS ENERGY SOURCES (LOCKOUT/TAGOUT)

This safe work practice (SWP) establishes minimum requirements for the lockout and tagout of energy-isolating devices whenever maintenance or servicing is performed on machines or equipment. This SWP will be used to ensure that the machine or equipment is stopped, isolated from all potentially hazardous energy sources, and locked out and tagged out before employees perform any servicing or maintenance during which the unexpected energization or startup of the machine or equipment or release of stored energy could cause injury. This document follows requirements of Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.147, the "Control of Hazardous Energy (Lockout/Tagout)."

The applicability of this SWP and definitions, responsibilities, and procedures associated with lockout and tagout are discussed below.

1.0 APPLICABILITY

This SWP applies to all Tetra Tech, Inc. (Tetra Tech), employees that may perform service or maintenance activities on equipment that could result in injury from equipment startup or energization. Only trained employees are allowed to perform lockout and tagout procedures in accordance with this SWP. Upon observing a machine or piece of equipment that is locked out and tagged out to perform servicing or maintenance, an employee shall not attempt to start, energize, or use that machine or equipment. Violation of this rule may result in immediate termination.

The following situations are exempt from the requirements of this SWP:

- Cord- and plug-connected electrical equipment under sole control of the employee performing the service or maintenance
- Installation of power by a utilities service

If work is conducted at a site where another contractor or the site has an existing lockout/tagout procedure, Tetra Tech shall inform the contractor or site personnel of Tetra Tech procedures and request access to their respective procedures.

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2.0 DEFINITIONS

Energy-isolating device: A mechanical device that physically prevents the transmission or release of energy

Lockout: Placement of a lockout device on an energy-isolating device to ensure that the energy-isolating device and the equipment being controlled cannot be operated until the lockout device is removed

Lockout device: A device that uses a positive means, such as a key or combination lock, to hold an energy-isolating device in a safe position and prevent energizing of machine or equipment

Tagout: Placement of a tag on an energy-isolating device to indicate that the energy-isolating device and the equipment controlled must not be operated until the tag is removed

Tagout device: A prominent warning device, such as an attached tag, that can be securely fastened to an energy-isolating device to indicate that the equipment may not be operated until the tag is removed

3.0 RESPONSIBILITIES

Regional health and safety representatives (RHSR) and subsidiary health and safety representatives (SHSR) will support operations managers in application of this SWP whenever necessary to their office-based projects. The operations manager may choose to delegate certain responsibilities, such as training and inspection, to the office health and safety representative (OHSR). The operations manager should contact a RHSR or SHSR for assistance with and evaluation of office implementation of this SWP.

Project managers shall ensure and enforce necessary lockout procedures on their projects. This responsibility may be delegated to the site safety coordinator for a specific project.

4.0 PROCEDURES

Procedures to ensure adequate energy control, employee training, and periodic inspections are discussed below.

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4.1 ENERGY CONTROL PROCEDURES

This section describes basic procedures to follow for machine or equipment lockout/tagout. Whenever feasible, equipment should be locked out. Only when lockout is physically not feasible may tagout be the sole means of energy control.

4.1.1 Lockout or Tagout Sequence

The following sequence of activities must be followed for proper lockout or tagout:

- All affected employees should be notified that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. The notification can be provided verbally, or else a written notice of intent to lockout for service or maintenance can be posted.

- The employee conducting the servicing or maintenance shall refer to all available reference materials and information sources to identify the type and magnitude of energy that powers the machine or equipment, shall understand the hazards of the energy, and shall know methods to control the energy.

- If the machine or equipment is currently operating, it must be shut down by the normal stopping procedure (such as depressing the stop button, opening the switch, closing the valve, or another method).

- The energy-isolating device(s) should be deactivated so that the machine or equipment is isolated from the energy source(s).

- The energy-isolating device(s) can then be locked out with assigned individual lock(s). Each lock must be accompanied by a "DANGER, DO NOT OPERATE" tag explaining why the equipment is locked out of service. Tags should contain complete information, such as name of servicing or maintenance employee, complete date, and reason for the tag. Tags must be written legibly. Each employee who has locked out the equipment will retain the lock key in his or her possession as long as the lock is installed.

  Note: Installing locks on ordinary stop-start stations is not considered a satisfactory electrical lockout. Lockout must occur at a circuit breaker, disconnect switch, block, or any similar device to block or isolate energy.

- Stored or residual energy (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure) must be dissipated or restrained by methods such as grounding, repositioning, blocking, or bleeding down, as appropriate.

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- Personnel should ensure that the equipment is disconnected from the energy source(s) by first checking that no personnel are exposed, and then by verifying the isolation of the equipment by operating the "on" switch or other normal operating control(s) or by testing to make certain that the equipment will not operate.

  Caution: Operating controls should be returned to a neutral or "off" position after isolation of the equipment is verified.

- The machine or equipment is now locked out.

Each employee working on the equipment must be satisfied that it is safe for him or her to proceed with the work. Only the employee who has placed the lock can remove it, even if that person leaves the area with the lock or tag left on the equipment.

4.1.2 Restoration of Equipment to Service

When the servicing or maintenance job is completed and the machine or equipment is ready to return to normal operating conditions, the following steps shall be taken:

- The machine or equipment and the area around the machine or equipment should be checked to ensure that nonessential items have been removed and that machine or equipment components are operationally intact.
- The work area should be checked to ensure that all employees have been safely positioned or removed from the area.
- The controls should be in a neutral or "off" position.
- The lockout or tagout devices should be removed and the machine or equipment re-energized.
- Affected employees should be notified that the servicing or maintenance is completed and the machine or equipment is ready for use.

  Note: Some forms of blocking may require re-energization of the machine before the blocking can be safely removed.

4.2 EMPLOYEE TRAINING

Training shall be provided to all employees who may be required to use lockout and tagout procedures. The training shall cover the following topics as mandated in 29 CFR 1910.147:

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- Types of energy sources anticipated
- Methods of energy isolation and control
- Purpose and use of energy control procedures
- Limitations of tagout

Retraining will be provided any time potential energy sources change or deviations are noted in techniques and procedures used by trained employees that do not comply with previously taught methods.

A roster of employees attending training sessions will be maintained and contain attendee signatures, attendance dates, and the content of the training program. Training will typically be included with annual refresher training sessions as discussed in "Health and Safety Training Program," Document Control No. 3-1.

4.3 PERIODIC INSPECTIONS

At a minimum, inspections of compliance with this SWP by field staff will be conducted as required by 29 CFR 1910.147(c)(6). Because of the low frequency of use of this SWP, compliance inspections will be conducted randomly by the SSC on projects with known lockout and tagout needs.

Inspections will be documented using the "Lockout/Tagout Inspection Certificate" (Form LOTO-1) in Volume III, Forms.

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SAFE WORK PRACTICES (SWP)

SAFE DRILLING PRACTICES

SWP NO.: 6-3

ISSUE DATE: JULY 1998

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SAFE DRILLING PRACTICES

This document establishes safe work practices (SWP) to follow during drilling operations. These SWPs are based on suggested safety procedures provided in the National Drilling Association's "Drilling Safety Guide." Procedures to follow before, during, and after drilling are listed below.

Before beginning any drill operation, each employee must be aware of the following:

- Wear a hard hat, safety glasses or goggles, steel-toed work boots, a shirt and full-length pants when working with or near the drill rig. Shirts must be tucked in at the belt.
- Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working with rotating equipment.
- Do not eat, drink, or smoke near the drill rig.
- Identify all underground utility and buried structure locations before drilling.
- Ensure that the drill rig and any other machinery used is inspected daily by competent, qualified individuals. The site safety coordinator (SSC) will ensure compliance with this precaution.
- Drill rig operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC.
- Establish hand-signal communications for use when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators.

While the drill rig is operating, employees should be aware of the following:

- Wear appropriate respiratory and personal protective equipment (PPE) when conditions warrant their use.
- Avoid direct contact with known or suspected contaminated surfaces.
- Move tools, materials, cords, hoses, and debris to prevent tripping hazards and contact with moving drill rig parts.
- Adequately secure tools, materials, and equipment subject to displacement or falling.
- Store flammable materials away from ignition sources and in approved containers.

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- Maintain adequate clearance of the drill rig and mast from overhead transmission lines. The minimum clearance is 25 feet unless special permission is granted by the utility company. Call the local utility company for proper clearance.

- Only qualified and licensed personnel should operate drill rigs.

- Workers should not assume that the drill rig operator is keeping track of their exact location. Workers should never walk directly behind or beside heavy equipment without the operator's knowledge.

- Workers should maintain visual contact with drill rig operators at all times.

- When an operator must maneuver equipment in tight quarters, the presence of a second person is required to ensure adequate clearance. If much backing is required, two ground guides will be used: one in the direction the equipment is moving, and the other in the operator's normal field of vision to relay signals.

- Auger sections and other equipment are extremely heavy. All lifting precautions should be taken before moving heavy equipment. Appropriate equipment, such as chains, hoists, straps, and other equipment, should be used to safely transport heavy equipment too heavy to safely lift.

- Proper personal lifting techniques will be used. Workers should lift using their legs, not their backs.

- Workers will not use equipment they are not familiar with. This precaution applies to heavy as well as light equipment.

- All personnel not essential to work activities will be kept out of the work area.

- Workers will be aware of their footing at all times.

- Workers will remain alert at all times.

After drilling operations are completed, employees should do the following:

- Shut down machinery before repairing or lubricating parts (except parts that must be in motion for lubrication).

- Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded to prevent the buildup of static electricity.

- Keep drill rigs in the exclusion zone until work has been completed. Such equipment should then be decontaminated within the designated decontamination area.

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- Engage parking brakes when equipment is not in use.

- Implement an ongoing maintenance program for all tools and equipment. All tools and moving equipment should be inspected regularly to ensure that parts are secured, are intact, and have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate in accordance with manufacturer specifications. Defective items should be promptly repaired or replaced. Maintenance and repair logs will be kept.

- Store tools in clean, secure areas to prevent damage, loss, or theft.

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SAFE WORK PRACTICES (SWP)

EXCAVATION PRACTICES

SWP NO.: 6-4

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EXCAVATION PRACTICES

This safe work practice (SWP) outlines minimum requirements to protect employees who may be exposed to hazards during trenching and excavation activities and to provide general guidance for compliance with Title 29 of the *Code of Federal Regulations* (CFR), Part 1926, Subpart P, "Excavations."

Project managers shall ensure that all excavation, shoring, and trenching activities are conducted in accordance with the requirements outlined in this document and Subpart P of 29 CFR 1926. Project managers must also ensure that projects involving trenching and excavation are staffed by an individual capable of performing "competent person" duties as described in this procedure.

The site safety coordinator (SSC) is responsible for on-site enforcement of this SWP.

Definitions and procedures used for excavations are discussed below.

1.0 DEFINITIONS

The following definitions apply to this SWP:

Benching: Forming one or a series of horizontal levels or steps in the sides of an excavation to protect employees from cave-ins

Competent Person: One capable of identifying existing or predictable hazards in the work environment that are unsanitary or dangerous to employees and who has authorization to take prompt corrective measures to eliminate the hazards

Excavation: Any manmade cut, cavity, trench, or depression in an earth surface formed by earth removal

Shoring: Metal, hydraulic, mechanical, or timber system that supports the sides of an excavation and that is designed to prevent cave-ins

Sloping: Sloping the sides of an excavation at an incline away from the excavation to protect employees from cave-ins

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Trench: A narrow excavation (in relation to its length) that is usually deeper than it is wide but less than 15 feet wide

2.0 PROCEDURES

Described below are the general safety requirements and protective system requirements for trenching and excavation activities.

2.1 GENERAL SAFETY REQUIREMENTS

General safety requirements that must be in place before work begins are as follows:

- Utility companies or a utilities locating service in the area must be notified **before excavation or trenching activities begin** to arrange for locating and protecting underground utilities.
- Access to trenching areas must be controlled and limited to authorized personnel. Prior to entering a trench or excavation, workers must notify the project manager, SSC, and nearby equipment operators whose activities could affect the trench or excavation.
- No person may enter a trench or work at the foot of the face of an excavation until a qualified, competent person has inspected the excavation and determined whether sloping or shoring is required to protect against cave-in or subsidence and the appropriate protection has subsequently been installed.
- Trenches and excavations must be assessed by a qualified, competent person, even in the absence of working personnel, whenever heavy equipment will be operating nearby in order to ensure that the trench or excavation will support the weight of the equipment without subsistence or causing the accidental overturning of machinery.
- Trenches and excavations must be inspected regularly (daily at a minimum) to ensure that changes in temperature, precipitation, shallow groundwater, overburden, nearby building weight, vibration, or nearby equipment operation have not caused weakening of the sides, faces, and floors and to ensure that personnel protection is being maintained.
- When subsidence or tension cracks are apparent anywhere in an excavation, all work should be stopped until the problem is corrected.
- The competent person must inspect trenches or excavations after any precipitation event to ensure integrity has been maintained.
- Sufficient ramps or ladders must be provided in excavations 4 or more feet deep to allow quick egress. Ramps or ladders may be placed no more than 25 feet apart, must be

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secured from shifting, and must extend at least 3 feet above the top of the trench or excavation. Structural ramps must be designed by a competent person.

- Material removed from an excavation or trench must be placed far enough from the edge (at least 2 feet) to prevent it from sliding into the excavation or trench or from stressing the trench or excavation walls. Worker protection must also be provided from loose rock or soil on the excavation faces.

- 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.

- 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 a walkway or roadway.

- When a hazardous atmosphere could exist, the excavation must be tested for appropriate hazardous substances and oxygen level before personnel entry. Excavation where hazardous atmospheres exist must be treated as a confined space. Entry must follow procedures outlined in "Confined Spaced Entry Program," Document Control No. 2-5.

- Entry is not allowed into excavations where water has accumulated.

2.2 PROTECTIVE SYSTEM REQUIREMENTS

Protective systems protect employees from cave-ins, material that could fall in or roll off the face of the excavation, and collapse of adjacent structures. Protective systems include shoring, shielding, sloping and benching, and other systems. Sloping and benching and shoring system requirements are described below.

2.2.1 Sloping and Benching Requirements

Sloping and benching system construction must follow the guidelines established in Appendix B to Subpart P of 29 CFR 1926. Maximum allowable slopes for excavations are summarized below. All slopes indicated are expressed as the ratio of horizontal distance (H) to vertical rise (V).

Soil or Rock Type	Maximum Allowable Slope (H:V) for Excavations Less than 20 Feet Deep
Stable Rock	Vertical (90°)
Type A	0.75:1 (53°)
Type B	1:1 (45°)
Type C	1.5:1 (34°)

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Soil types are defined in Appendix A to Subpart P of 29 CFR 1926 and are summarized below.

Type A: Cohesive soils with an unconfined compression strength of 1.5 tons per square foot (ton/ft^2) or greater (such as clay, silty clay, sandy clay, or clay loam)

Type B: Cohesive soils with an unconfined compression strength of greater than 0.5 but less than 1.5 ton/ft^2 (such as angular gravel, silt, silt loam, or sandy loam)

Type C: Cohesive soils with an unconfined compression strength of less than 0.5 ton/ft^2 (such as gravel, sand, loamy sand, submerged soil, or unstable submerged rock)

Sloping and benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.

Soil types must be determined by the competent person using at least one visual and one manual test. Manual tests include plasticity, dry strength, thumb penetration, and drying tests.

2.2.2 Shoring System Requirements

Appendixes C, D, and E to Subpart P of 29 CFR 1926 outline requirements for timber shoring for trenches, aluminum hydraulic shoring for trenches, and alternatives to timber shoring, respectively. Guidelines for shoring systems are listed below.

- If it is not economically feasible or there are space restrictions to prevent cutting the trench or excavation walls back to a safe angle of repose, all trenches or excavations 5 feet deep or more must be shored.
- Shoring should be erected as trenching or excavation progresses and as closely as possible to the excavation floor.
- Shoring timber dimensions must meet the minimum timber requirements specified in Tables C1.1 through C1.3 of Appendix C to Subpart P 29 CFR 1926. Aluminum hydraulic shoring must be constructed using the guidelines and dimension requirements specified in Appendix D of the same standard.

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- Trench shields may be used instead of shoring or bracing. Shields must be constructed of steel flat sides welded to a heavy framework of structural pipe. Shields should be moved along by the excavator as trenching or excavation proceeds.

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SAFE WORK PRACTICES (SWP)

WORKING OVER OR NEAR WATER

SWP NO.: 6-5

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WORKING OVER OR NEAR WATER

This safe work practice (SWP) provides guidelines for working over or near bodies of water 3 or more feet deep or swiftly moving water. Workers will observe the requirements of the Occupational Safety and Health Administration (OSHA) specified in Title 29 of the *Code of Federal Regulations* (CFR), Part 1926.106, "Working Over or Near Water." The following sections discuss general procedures, underwater work, and cold water procedures.

1.0 GENERAL PROCEDURES

When working over or near water, the following precautions will be taken:

- All staff and team members must wear a personal flotation device (PFD) within 15 feet of a water body. Personnel will be provided with U.S. Coast Guard (USCG)-approved life jackets or work vests. The PFD should be Class III, which will support the head of an unconscious person above water.
- Life jackets and work vests will be inspected before each use.
- A USCG-approved life-saving skiff will be available.
- Under no circumstances will team members enter water bodies without protective clothing such as rubber boots or waders.
- At least one person will remain on shore as a look-out.

If a team member falls into the water, under no circumstances should another team member enter the water to rescue the person in the water. If possible, a branch, paddle, pole, or similar object should be extended to the person in the water. When the person in the water grabs the extended item, they should be pulled toward the shore or boat. If the person is unconscious, the PFD, clothing, or hair should be hooked to pull the person toward the shore or boat. Once the person has been safely retrieved, necessary emergency medical procedures should be performed by qualified personnel. If none are necessary, the retrieved team member should change into dry clothing as soon as possible after any necessary personal decontamination.

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2.0 UNDERWATER WORK

Underwater work should be performed in accordance with the procedures and guidelines of the Diving Safety Program (Document Control No. 2-15 in Volume I).

3.0 COLD WATER PROCEDURES

When the water temperature is below 45 °F, hypothermia is a serious risk. A person can loose feeling in the extremities within 5 minutes. All field staff members should be familiar with cold water survival techniques or should receive training from an American Red Cross-certified swimming instructor in cold water survival techniques when site conditions warrant such knowledge.

After a person has been rescued from cold water, he or she should change into dry clothes as soon as possible. If the person who has fallen into the water displays hypothermia symptoms, he or she should be treated immediately and taken to a medical facility. Under no circumstances should the hypothermia victim be given hot liquids because this could accelerate shock. Drinks no warmer than normal body temperature are acceptable. If symptoms are severe and evacuation to a medical facility cannot be quickly conducted, any wet clothing should be removed, the victim should be placed in blankets or sleeping bags in a sheltered location, and the rescuer should climb into the blankets or sleeping bag with victim to provide additional warmth. The victim should also be treated continuously for shock, elevating feet and monitoring the victim's pulse and breathing rate.

If a team member falls into cold water, he or she should not remove any clothing while in the water because clothing provides additional insulation. Although clothing creates an added drag while swimming, the insulation outweighs the disadvantage of the additional drag. Each team member should carry a wool hat to place on his or her head in case he or she falls into the water. A wool hat, even when wet, provides good insulation for the head, where a large amount of body heat is lost.

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SAFE WORK PRACTICES (SWP)

FALL PROTECTION PRACTICES

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FALL PROTECTION PRACTICES

This safe work practice (SWP) presents general guidelines for basic fall protection when working in elevated areas. Continuous elevated work or elevated construction work will require detailed procedures included in a site-specific health and safety plan. SWP No. 6-10, "Portable Ladder Safety," should also be consulted. During elevated work, the precautions below must be taken.

- All fall hazards should be identified at work sites with the potential for elevated work. Once an elevated fall hazard has been recognized, an appropriate control measure must be selected. Priority should be given to elimination of the fall hazard over the use of fall protection equipment.
- Approved safety harnesses and lanyards shall be worn by employees whose work exposes them to falls of greater than 6 feet.
- Lanyards should be anchored at a level no lower than the employee's waist to limit the fall distance to a maximum of 4 feet and to not allow the employee to contact the next lower work level, where practical.
- All fall protection devices should be used only in accordance with manufacturer's recommendations.
- All fall protection devices shall be inspected daily before use.
- Any lifeline, harness, or lanyard actually subjected to in-service loading (a fall) should be immediately removed from service and not used again for employee fall protection.
- Anchor points and lanyards capable of supporting a minimum dead weight of 5,400 pounds should be used.
- Employees who are required to wear fall protection should be trained in the use of the equipment, as well as in fall protection work practices.

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SAFE WORK PRACTICES (SWP)

PORTABLE LADDER SAFETY

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PORTABLE LADDER SAFETY

This safe work practice (SWP) applies to portable ladders only. Fixed ladder systems shall be used when regular access is required such as for entering storage tanks and raised work platforms. These SWPs follow the regulatory requirements for ladders as found in Title 29 of the *Code of Federal Regulations* (CFR) Part 1926.1053. Procedures to ensure portable ladder safety are listed below.

- Ladders should be maintained in good condition at all times. Damaged ladders shall be withdrawn from service immediately.
- Ladders should be inspected regularly and removed from service and repaired or discarded if defective.
- Rungs should have slip-resistant surfaces and be kept free of grease and oil.
- Tops and pail shelves of portable stepladders should not be used as steps.
- Rung and cleat ladders should be placed so that the horizontal distance from the top support to the foot of the ladder is one-quarter of the working length of the ladder.
- Ladders should not be placed in front of doorways, drives, or passageways.
- Ladders should not be placed on boxes, barrels, or other unstable bases to add height.
- Employees should always face the ladder during ascent or descent.
- Metal ladders should not be used in areas with the potential for contact with electric circuits.
- Ladder side rails shall extend at least 3 feet above the upper landing surface to which the ladder is used to access.
- Ladder shall be used only on stable and level surfaces. Do not use ladders on slippery surfaces.

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SAFE WORK PRACTICES (SWP)

DRUM AND CONTAINER HANDLING PRACTICES

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DRUM AND CONTAINER HANDLING PRACTICES

This safe work practice (SWP) establishes procedures to protect field personnel and the public from exposure to hazardous materials resulting from the handling, opening, sampling, transferring, overpacking, and shipping of drums.

Regional health and safety representatives (RHSR) and subsidiary health and safety representatives (SHSR) are responsible for providing technical guidance to project managers and site safety coordinators (SSC) on drum and container handling procedures. Project managers are responsible for ensuring implementation of this SWP, when warranted, on their projects. SSCs are responsible for enforcement of this SWP at the work site. Field personnel are required to adhere to drum and container handling guidelines and procedures.

All drum and container handling operations must adhere to all applicable federal, state, local, contractual, and company requirements. Preparation and shipping of containers of hazardous materials must comply with applicable U.S. Environmental Protection Agency (EPA) and U.S. Department of Transportation (DOT) regulations. All drums and containers used during hazardous waste operations must meet appropriate DOT regulations for the materials they contain.

Drum and container handling should be approached in a systematic, stepwise manner, especially when the contents are unknown or containers are in poor condition. Inspection, opening, sampling, overpacking, and staging requirements for drums and containers are described below.

1.0 INSPECTION

Drums or containers should be visually inspected before any work is conducted to gain as much information as possible about their contents. Field personnel should document in the field logbook the following information:

- Any labels or other markings indicating possible contents
- Drum or container condition (such as rusted, leaking, or dented)
- Signs of pressure (such as bulging or swelling)

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- Drum or container size, construction, and type
- Configuration of drum or container head (open or closed top)

After observations are documented in the field logbook, each drum or container should be labeled with an identification code for future tracking.

2.0 OPENING

For efficient and safe drum or container opening, personnel must adhere to the guidelines below.

- If available, remote-controlled drum or container opening equipment should be used.
- In order to protect the employee, a suitable shield shall be placed between the employee and the drum being opened.
- Only spark-proof tools should be used to open drums and containers.
- Drums or containers containing unknown materials should be opened using Level B personal protection, including splash protection.
- Drums or containers containing radioactive material should not be opened or handled until the appropriate personnel with expertise in this area have been consulted.
- Air monitoring equipment should be available near the drum or container being opened, such as combination oxygen and combustible gas meters, colorimetric tubes, and photoionization detectors.
- Tools used for drum or container opening should be decontaminated after each use to avoid mixing incompatible wastes.
- Drums or containers should be resealed as soon as possible to minimize vapor generation.
- If possible, drums or containers exhibiting signs of pressure should not be opened.

3.0 SAMPLING

Drum and container sampling poses a variety of potential hazards to worker health and safety, including direct contact with hazardous materials, inhalation of hazardous vapors, and the possibility of drum or container explosion or rupture. The guidelines below should be used to properly sample drums and containers.

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- Prior to sampling, a sample plan must be developed that includes the following information:
  - Background information on the waste
  - Which drums or containers will be sampled
  - Appropriate sampling devices
  - Sample containers to be used
- Sampling personnel should not stand on drums or containers or lean over other drums or containers to obtain samples.
- All phases in the vertical cross section of each drum or container should be sampled.
- Disposable glass tubing or other disposable sampling devices should be used to sample liquid.
- When sampling liquids, absorbent pads should be placed on drum tops to collect spillage that may occur while transferring samples into containers.
- Sampling personnel should document container number, any container labeling, sampling date and time, and number and color of different phases.

4.0 OVERPACKING

During an emergency, drums and containers should be handled as detailed below.

- Leaks should be plugged or patched immediately if this can be done without risk.
- Damaged drums and containers should be placed in an overpack container with absorbent pads to collect any spilled material or the contents transferred into a clean, compatible drum or container.
- Absorbent material should be used to collect any leakage that may occur during shipment.

During remedial actions, the procedures below apply to drum and container handling.

- Drums or containers should be placed in overpack containers, and any identification number assigned to the drum or container should be placed on the outside of the overpack container.

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- If drum or container contents are to be bulked with other drum or container contents, the compatibility of the contents should be verified by a field characterization study prior to bulking.

5.0 STAGING

Staging refers to moving drums or containers in an organized manner to predesignated areas. Drums or containers may be staged to facilitate characterization and remedial action and also to protect drums or containers from potentially hazardous site conditions (such as high temperatures and proximity to ignition sources or heavy equipment). To ensure that staging is conducted in a safe and efficient manner, the guidelines below should be followed.

- Staging activities should be kept to a minimum to prevent hazards associated with increased handling of drums or containers.
- The staging area should be as close as possible to the site exit.
- The staging area should be level and covered with plastic sheeting or absorbent material.
- The staging area should be diked to contain possible spills.
- Drums or containers should be secured on pallets whenever possible to aid in the safe movement of drums or containers and to isolate the drums or containers from the soil surface.
- Drums or containers should not be stacked on top of each other.
- Drums or containers should be staged according to chemical composition of the contents. Drums or containers containing incompatible materials should be kept segregated.
- Drums and containers should be staged far enough apart to allow for the movement of equipment and personnel.

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TETRA TECH, INC.
HEALTH AND SAFETY MANUAL
VOLUME III

SAFE WORK PRACTICES (SWP)

DANGEROUS GOODS SHIPMENT

SWP NO.: 6-12

ISSUE DATE: JANUARY 2002

REVISION NO.: 0

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DANGEROUS GOODS SHIPMENT

This safe work practice (SWP) was developed by Tetra Tech, Inc. (Tetra Tech), to describe basic procedures for identifying, classifying, packaging, and shipping dangerous goods. These SWP procedures should be followed to ensure the integrity of items being shipped and to protect the welfare of persons involved in their shipment, transport, and receipt. When a common carrier is used, the U.S. Department of Transportation (DOT) Hazardous Materials Regulations (HMR) in Title 49 of the *Code of Federal Regulations* (49 CFR), Parts 106 through 180, and the International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR) apply to the packaging, labeling, and shipment of dangerous goods. Tetra Tech employees are trained in specific procedures for properly shipping dangerous goods that Tetra Tech employees may encounter on a routine basis. This SWP emphasizes procedures for shipping dangerous goods by air under the DGR because Tetra Tech primarily uses Federal Express (FedEx) for shipping these goods. HMRs are also discussed for ground shipments.

This SWP's applicability, definitions, procedures, and potential problems associated with shipping dangerous goods are discussed below, followed by a list of references used to prepare this SWP.

1.0 APPLICABILITY

This SWP applies to all dangerous goods shipments made by Tetra Tech employees. Examples of employees who may ship dangerous goods include environmental field personnel and office employees who may ship dangerous goods to personnel in support of field operations. All persons shipping dangerous goods must have the training specified in the DGR and HMR. This training is required at least once every 2 years according to the DGR and once every 3 years according to the HMR. Training can be conducted by an outside vendor or in-house by a person trained in accordance with DGR and HMR requirements. IATA-approved training schools are listed in the index to the DGR. FedEx, although it is not listed in the index to the DGR, also provides training on shipping dangerous goods.

2.0 DEFINITIONS

Terms related to the shipment of dangerous goods are defined below.

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Dangerous goods: Dangerous goods are articles or substances capable of posing a significant risk to health, safety, or property when transported by air and that are classified into the nine hazardous classes in Section 3 of the DGR (IATA 1999).

Dangerous Goods Regulations (DGR): DGRs govern international transport of dangerous goods by air and are based on the International Civil Aviation Organization (ICAO) Technical Instructions. DGRs cover all the ICAO Technical Instruction requirements and are more restrictive in some cases.

Environmental sample: Environmental samples include drinking water; most groundwater and ambient surface water, soil, and sediment; treated municipal and industrial wastewater effluent; and biological specimen samples. Environmental samples typically contain low concentrations of contaminants and require only limited precautionary procedures.

Hazardous material: A hazardous material is capable of posing an unreasonable risk to health, safety, or property when transported in commerce.

Hazardous Materials Regulations (HMR): The HMR are DOT regulations for shipment of hazardous materials by air, water, and land and are documented in 49 CFR, Parts 106 through 180.

Hazardous substance: A hazardous substance is a material, including its mixtures and solutions, listed in Appendix A of 49 CFR 172.101 **and** that is in a quantity (in one package) that equals or exceeds the reportable quantity (RQ) listed in Appendix A of 49 CFR 172.101 (see 49 CFR 171.8).

Operator: An operator is an entity that accepts or transports goods, such as FedEx or the United Parcel Service (UPS).

Overpack: An overpack is an enclosure used by a single shipper to contain one or more packages and to form one unit for handling and storage convenience (IATA 1999). An example of an overpack is a cardboard box or cooler used to contain multiple dangerous goods packages in order to make handling easier and to save on shipping costs.

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Shipper: A shipper is an entity that prepares goods for transport, such as the person who packs goods in a shipping container.

3.0 DANGEROUS GOODS SHIPMENT PROCEDURES

The procedures presented below for classifying, packaging, and shipping dangerous goods must be followed by Tetra Tech employees.

3.1 DANGEROUS GOODS CLASSIFICATION

Prior to any shipment, the material being shipped must be classified with regard to whether it is subject to the DGR. If dangerous goods are to be shipped by air (using FedEx, for example), the DGR must be followed and not the HMR. As its name implies, IATA is an association of airlines, and any airline belonging to IATA must follow the DGR. FedEx is a member of IATA, and FedEx **will not** accept any package for shipment that is not packaged and labeled in accordance with the DGR. In most cases, packaging and labeling requirements under the DGR and HMR are the same. The HMR states that a hazardous material can be transported by aircraft in accordance with the ICAO Technical Instructions (see 49 CFR 171.11), which the DGR is based on. Therefore, use of the DGR for dangerous goods shipment by air complies with the HMR.

Dangerous goods are (1) classified in accordance with Section 3 of the DGR; (2) are listed in bold type in the "List of Dangerous Goods" in the DGR; (3) are considered hazardous materials (see the definition in Section 2.0) when the materials are shipped in the United States; or (4) have a special mention in Section 2, "Limitations," of the DGR for particular countries of transport or airlines (such as FedEx). Most environmental samples (see the definition in Section 2.0) are not dangerous goods and do not need to be packaged in accordance with the DGR or HMR. The hazard classifications specified in the DGR and the HMR are listed below:

Class 1 – Explosives

Division 1.1 - Articles and substances having a mass explosion hazard
Division 1.2 - Articles and substances having a projection hazard but not a mass explosion hazard
Division 1.3 - Articles and substances having a fire hazard, a minor blast hazard, and/or a minor projection hazard but not a mass explosion hazard
Division 1.4 - Articles and substances presenting no significant hazard

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Division 1.5 - Very insensitive substances having a mass explosion hazard
Division 1.6 - Extremely insensitive articles that do not have a mass explosion hazard

Class 2 - Gases

Division 2.1 - Flammable gas
Division 2.2 - Nonflammable, nontoxic gas
Division 2.3 - Toxic gas

Class 3 - Flammable Liquids (no divisions)

Class 4 - Flammable Solids; Substances Liable to Spontaneous Combustion; Substances that, in Contact with Water, Emit Flammable Gases

Division 4.1 - Flammable solid
Division 4.2 - Substances liable to spontaneous combustion
Division 4.3 – Substances that, in contact with water, emit flammable gases

Class 5 - Oxidizing Substances and Organic Peroxide

Division 5.1 - Oxidizer
Division 5.2 - Organic peroxides

Class 6 - Toxic and Infectious Substances

Division 6.1 - Toxic substances
Division 6.2 - Infectious substances

Class 7 - Radioactive Material (no divisions)

Class 8 - Corrosives (no divisions)

Class 9 - Miscellaneous Dangerous Goods (no divisions)

The criteria for each of the first eight classes are very specific and are outlined in Section 3 of the DGR and in the HMR (see 49 CFR, Part 173). Some of the classes and divisions are further divided into packing groups based on the level of danger. Packing Group I indicates a great danger, Packing Group II indicates a medium danger, and Packing Group III indicates a minor danger.

The hazard classes most often used by Tetra Tech personnel are discussed below. Further details for hazard classes not discussed below are presented in Section 3 of the DGR.

- Class 2, Gases, includes any compressed gas and any noncompressed gas that is either flammable or toxic. A compressed gas is defined as having a pressure over 40 pounds

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per square inch (psi) absolute (25 psi gauge). Most air samples and empty cylinders that do not contain a flammable or toxic gas are exempt from the DGR. An empty hydrogen cylinder, such as a cylinder from a flame ionization detector (FID), is considered a dangerous good unless it is properly purged with nitrogen in accordance with the HMR. A landfill gas sample is usually considered a flammable gas because it may contain a high percentage of methane.

- Class 3, Flammable Liquids, is based on the boiling point and flashpoint of a substance. Class 3 dangerous goods include solvents, oil, gas, and paint-related materials. Tetra Tech may collect samples of these materials from drums, tanks, or pits.

- Class 6, Toxics and Infectious Substances, Division 6.1, Toxic Substances, is based on oral toxicity, dermal toxicity, and inhalation toxicity lethal dose and lethal concentration values. Division 6.1 substances include pesticides and cyanide.

- Class 7, Radioactive Material, is defined as any article or substance with a specific activity greater than 70 kilobecquerels per kilogram (kBq/kg) or 0.002 microcurie per gram (FCi/g). If a substance's specific activity exceeds this level, the substance should be shipped in accordance with Section 10 of the DGR.

- Class 8, Corrosives, is based on the rate at which a substance destroys skin tissue or corrodes steel and is not based on pH. Class 8 materials include concentrated acids used to preserve water samples. However, preserved water samples are not considered Class 8 substances and can be packaged as nonhazardous samples. Shipments of the acids themselves should be packaged in accordance with the DGR.

- Class 9, Miscellaneous Dangerous Goods, includes substances that present a danger but are not covered by any other hazard class. Examples of Class 9 substances that Tetra Tech may ship include asbestos, polychlorinated biphenyls (PCB), and dry ice.

The HMR includes combustible liquids in Class 3, but the DGR does not. The definition of a combustible liquid is presented in the HMR (see 49 CFR 173.120). The HMR has an additional class, ORM-D, that the DGR does not specify. ORM-D material is defined by the HMR as a material such as a consumer commodity that, although it is otherwise subject to the HMR, presents a limited hazard during transport because of its form, quantity, and packaging. In order to allow shipment, an item classified as ORM-D material must be listed as a material for which exceptions are provided in the table in 49 CFR 172.101. The DGR lists consumer commodities as Class 9 materials. Tetra Tech does not normally ship consumer commodities during its environmental field operations.

The hazards associated with a material sampled at a field site are often unknown because no laboratory testing has been conducted. In such situations, an educated guess must be made about the hazard

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associated with the material based on knowledge of the site, field observations, field screening tests, and other available information.

Samples transported to a laboratory for testing or treatability studies, including samples of hazardous wastes, are **not** considered hazardous wastes under 40 CFR, Parts 261.4(d) and (e). FedEx will not accept shipments of hazardous waste.

Each division or subsidiary of Tetra Tech should have a list of dangerous goods that may be shipped under contract with a 24-hour emergency response service (such as Info Trac, Inc.).

3.2 DANGEROUS GOODS PACKAGING

The procedures to be followed for packaging dangerous goods are presented below. According to the DGR, all spellings used must be exactly as they appear in the List of Dangerous Goods, and only approved abbreviations may be used. For each DGR cited below, the corresponding HMR is also cited in parentheses. The HMR must be followed only if dangerous goods are being shipped by ground transport. Figure 1 depicts a correctly marked and labeled dangerous goods package.

1. Determine the proper shipping name for the material to be shipped. All appropriate proper shipping names are listed in Column B of the List of Dangerous Goods table in Section 4 of the DGR (or in Column 2 of the Hazardous Materials Table in 49 CFR 172.101). In some cases, a generic name is chosen based on the hazard class of the material. For example, a sample of oily liquid collected from a drum with a high photoionization detector (PID) reading should be packaged as a flammable liquid. The proper shipping name for this sample would be “flammable liquid, n.o.s.” The abbreviation “n.o.s.” stands for “not otherwise specified” and is used for generic shipping names. Typically, a technical name, such as acetone, should be parenthetically inserted after an n.o.s. description. However, when a sample whose components are not known is being shipped for testing purposes, a technical name is not required. If a hazardous substance (see the definition in Section 2.0) is being shipped, the letters “RQ” must appear in front of the proper shipping name.

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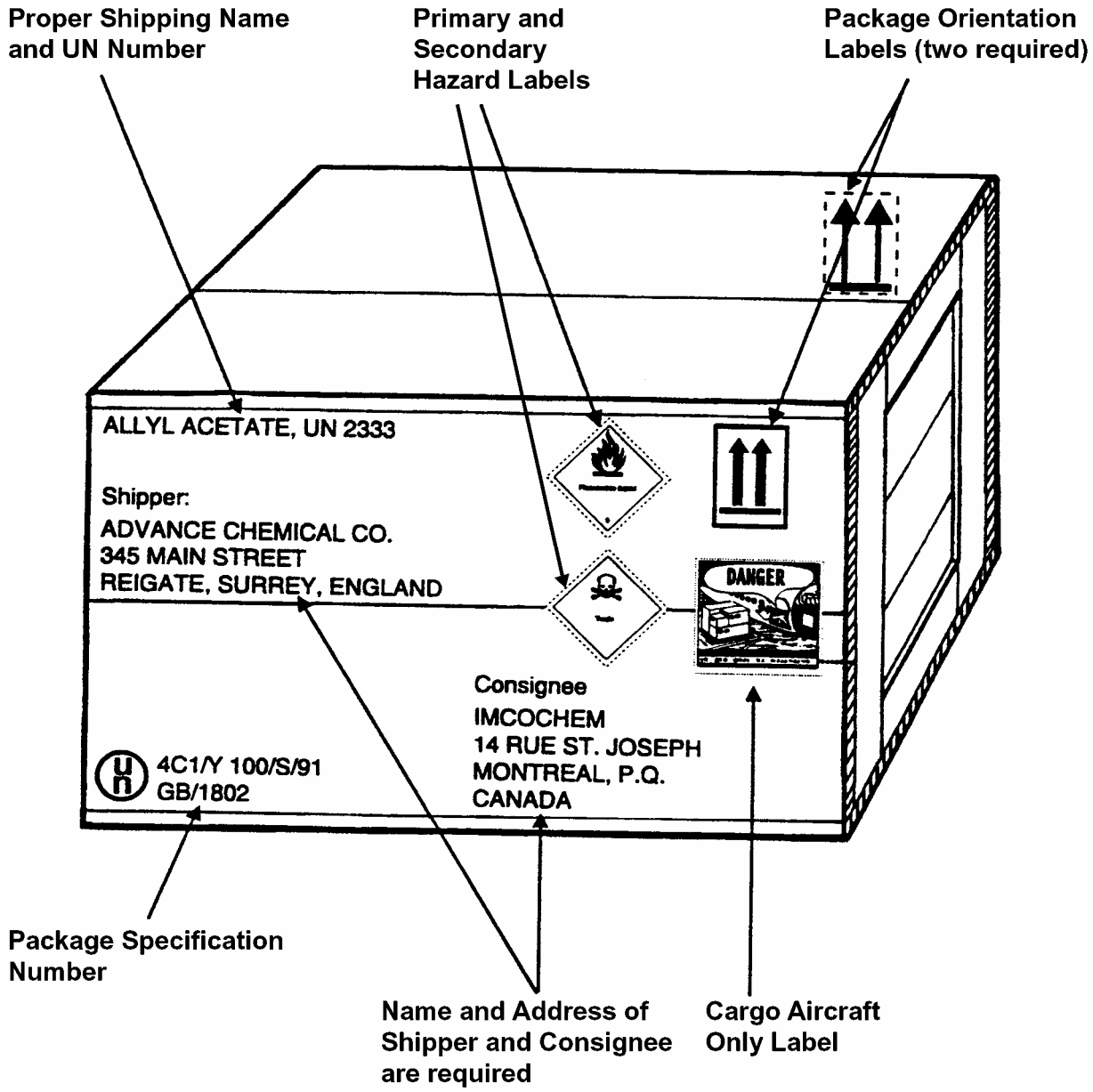
FIGURE 1

EXAMPLE OF A CORRECTLY MARKED AND LABELED DANGEROUS GOOD PACKAGE



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2. Determine the United Nations Committee of Experts on the Transport of Dangerous Goods (UN) identification number, the class or division, the subsidiary risk (if any), the required hazard labels, the packing group, and either the passenger aircraft or the "Cargo Aircraft Only" packing instructions based on the quantity of materials being shipped in one package. This information is presented in the List of Dangerous Goods (or the Hazardous Materials Table in 49 CFR, Part 172.101) under the appropriate proper shipping name. A "Y" in front of a packing instruction indicates a limited-quantity packing instruction. If dry ice or a limited quantity of a dangerous good is being shipped, shipping containers do not need to meet UN specifications.

3. Determine the packaging required to ship the dangerous goods. Codes for packing instructions are found in the List of Dangerous Goods table in Section 4 of the DGR. The instructions are defined in Section 5 of the DGR. Except for limited-quantity shipments and dry ice, UN specification packages that have been demonstrated to meet the packing group requirements for the material being shipped must be used. Specific testing requirements for the packages are listed in Section 6 of the DGR (or in the HMR in 49 CFR, Part 178). All UN specification packages have appropriate UN specification markings stamped on them. Prior planning is required to have the appropriate packages on hand when dangerous goods are expected to be shipped during a sampling event. Most dangerous goods can be shipped in either a 4G fiberboard box, a 1A2 steel drum, or a 1H2 plastic drum. Drums can be purchased in 5- and 20-gallon sizes and are ideal for shipping multiple hazardous samples. When FedEx is used, samples containing PCBs must be shipped in an inner metal package (a paint can) inside an outer 1A2 steel drum. This method of packaging samples containing PCBs is specified in FedEx variation FX-06 in Section 2 of the DGR. When unused sample preservatives are being shipped back to the supplier, the original packaging materials should be used, if appropriate.

4. For samples, place each sample jar in a separate, resealable plastic bag. Some UN specification packages contain the sample jars and plastic bags to be used.

5. Place the dangerous goods in the UN specification container or in another appropriate container if a limited quantity or dry ice is being shipped.

6. Pack the interior of the shipping container with enough noncombustible, absorbent, cushioning material (such as vermiculite) to prevent breakage and to absorb any liquid spilled.

7. Close and seal the shipping container in the appropriate manner for the type of container used. If return of the container is desired, affix instructions for returning the container to the shipper on the inside lid of the container.

8. Remove or obliterate all irrelevant labels and markings on the outer packaging.

9. Mark the outer packaging with the proper shipping name for the material to be shipped, UN identification number, name and address of the shipper, and recipient. These markings may be handwritten. For "carbon dioxide, solid" (dry ice), the net weight of the dry ice in the package must be marked on the outer packaging. For a limited-quantity

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shipment, the words "limited quantity" or "LTD. QTY." must be marked on the outer packaging.

10. Affix the appropriate hazard label to the outer packaging. Hazard labels are preprinted stickers available from various vendors. If the material being shipped poses a subsidiary hazard, a subsidiary hazard label must also be affixed to the outer packaging. The subsidiary hazard label is identical to the primary hazard label except that it does not have a hazard class or division number. It is also acceptable to obliterate the hazard class or division marking on a primary hazard label and use it as a subsidiary hazard label.

11. If cargo aircraft only packing instructions are being followed, the "Cargo Aircraft Only" label must be placed on the outer packaging.

12. Place package orientation labels ("up" arrows) on opposite sides of the outer packaging.

13. If an overpack (see the definition in Section 2.0) is being used, each outer packaging within the overpack must be marked and labeled as specified in Steps 8 through 12, and the overpack itself must be marked and labeled as specified in Steps 8 through 12. In addition, the statement "INNER PACKAGES COMPLY WITH PRESCRIBED SPECIFICATIONS" must be marked on the overpack. If more than one overpack is being used, mark the total quantity of dangerous goods contained in the overpacks on each overpack.

14. Place custody seals on the outer packaging if appropriate, and fill out shipping papers as described in Section 3.3.

3.3 DANGEROUS GOODS SHIPPING PAPERS-DOMESTIC ONLY

The requirements for shipping papers under the HMR are presented in 49 CFR, Part 172, Subpart C.

A "Shipper's Declaration of Dangerous Goods" (shipper's declaration) must be completed for each shipment of dangerous goods. The shipper's declaration must be attached to the air waybill. Although FedEx formerly supplied a combination air waybill and shipper's declaration, it no longer accepts shipments using the combination air waybill. In addition, **FedEx now requires that the Nature and Quantity of Dangerous Goods section of the shipper's declaration be typed. FedEx will not accept a dangerous good shipment if the Nature and Quantity of Dangerous Goods section of the shipper's declaration is handwritten.** However, FedEx does allow certain items to be handwritten on the shipper's declaration. To clarify, the items that may be handwritten include the following:

- Name and address of shipper and recipient

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- Air waybill number
- Airport of departure and destination
- Technical name of goods shipped in parentheses after proper shipping name
- Quantity
- Name, title, and signature, and place and date

The example of a completed shipper's declaration for a flammable liquid sample where the technical name is not known is shown in Figure 2 and displays items that can be handwritten and items that must be typed or computer-generated if FedEx is the shipper. For computer-generated forms, the hash marks along the two sides of the shipper's declaration must be red in color and two copies of the shipper's declaration must be included with the shipment. A shipper's declaration must contain the following information:

- Name and address of shipper and recipient
- Air waybill number (not applicable under the HMR)
- Indications on each page as follows: "Page __ of __"
- Deletion of either "Passenger and Cargo Aircraft" or "Cargo Aircraft Only," whichever does not apply
- Airport or city of departure
- Airport or city of destination
- Deletion of either "Non-Radioactive" or "Radioactive," whichever does not apply
- The nature and quantity of the dangerous goods, including the following information (in order) obtained from the List of Dangerous Goods in the DGR:
  - Proper shipping name
  - Class or division number
  - UN identification number
  - Packing group number

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FIGURE 2

EXAMPLE OF A SHIPPER'S DECLARATION FOR DANGEROUS GOODS

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper Joe Smith
Tetra Tech EM Inc.
200 E. Randolph Drive, Suite 4700
Chicago, IL 60601

Air Waybill No. 840000123456
Page 1 of 1 Pages
Shipper's Reference Number *(optional)*

Consignee Lab Manager
X42 Laboratories
123 Analyze Lane
Cincinnati, OH 45213

Two completed and signed copies of this Declaration must be handed to the operator.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non-applicable)*

PASSENGER AND CARGO AIRCRAFT	~~CARGO AIRCRAFT ONLY~~

Airport of Departure: Chicago

Airport of Destination: Cincinnati

WARNING

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

Shipment type: *(delete non-applicable)*

NON-RADIOACTIVE	~~RADIOACTIVE~~

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Good Identification							
Proper Shipping Name	Class or Division	UN or ID No.	Packing Group	Subsidiary Risk	Quantity and type of packing	Packing Inst.	Authorization
Flammable liquid, n.o.s.	3	UN 1993	III	--	4 glass jars in a 1A2 steel drum Net Quantity = 4.0L	309	A3 USG-14

Additional Handling Information: 24-hour Emergency Telephone Number: InfoTrac 800-535-5053
ERG# 128 Attached.

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations

Name/Title of Signatory
Joe Smith, Environmental Scientist
Place and Date
200 E Randolph, Chicago, IL 1/14/02
Signature *(see warning above)* Joe Smith

Form No. 30-065 Printed and Sold by UNIGO 700 Central Ave., New Providence, NJ 07974 • (800) 631-3098

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  - Subsidiary risk
  - Quantity in liters or kilograms (kg) and type of packaging used
  - Packing instructions
  - Authorizations (Authorizations include the words "limited quantity" or "LTD. QTY." if a limited quantity is being shipped, any special provision numbers in the List of Dangerous Goods, and the variation "USG-14" when a technical name is required after the proper shipping name but is not entered because it is unknown.)
  - Additional handling information

- Signature for the certification statement
- Name and title of signatory
- Place and date of certification statements
- A 24-hour emergency response telephone number for use in case of an incident involving the dangerous goods
- Emergency response information **attached** to the shipper's declaration (This information can be a material safety data sheet (MSDS) or the applicable pages of the "Emergency Response Guidebook" (ERG) (DOT, Transport Canada, and the Secretariat of Communications and Transportation of Mexico current edition). Figure 3 depicts the appropriate ERG emergency response information for "flammable liquids, n.o.s.")

Dry ice does not require an attached shipper's declaration. However, the air waybill must include the following information: "Dry ice, 9, UN1845, ____ x ____ kg." The blanks indicate the number of packages and the quantity (in kg) of each package, respectively. If FedEx is used, the box for dry ice in the Special Handling section of the air waybill must be checked, and the number of packages and quantity in each package must be entered. In addition, in the Special Handling section (Section 6), the boxes must be checked that indicate that the shipment contains dangerous goods and that a shipper's declaration is not required (see Figure 4).

If FedEx is used for a dangerous goods shipment that requires a shipper's declaration, the appropriate box in the Special Handling section of the air waybill must also be checked.

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FIGURE 3

ERG EMERGENCY RESPONSE INFORMATION FOR "FLAMMABLE LIQUIDS, N.O.S."

GUIDE 128 FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE) ERG2000

POTENTIAL HAZARDS

FIRE OR EXPLOSION

- **HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames.**
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors or in sewers.
- Those substances designated with a **"P"** may polymerize explosively when heated or involved in a fire.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Many liquids are lighter than water.
- Substance may be transported hot.

HEALTH

- Inhalation or contact with material may irritate or burn skin and eyes.
- Fire may produce irritating, corrosive and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control or dilution water may cause pollution.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 300 meters (1000 feet).

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

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ERG2000 FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE) **GUIDE 128**

EMERGENCY RESPONSE

FIRE

CAUTION: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient.

Small Fires

- Dry chemical, CO_2, water spray or regular foam.

Large Fires

- Water spray, fog or regular foam.
- Use water spray or fog; do not use straight streams.
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Car/Trailer Loads

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

SPILL OR LEAK

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- A vapor suppressing foam may be used to reduce vapors.
- Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Use clean non-sparking tools to collect absorbed material.

Large Spills

- Dike far ahead of liquid spill for later disposal.
- Water spray may reduce vapor; but may not prevent ignition in closed spaces.

FIRST AID

- Move victim to fresh air. • Call 911 or emergency medical service.
- Apply artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Wash skin with soap and water.
- Keep victim warm and quiet.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

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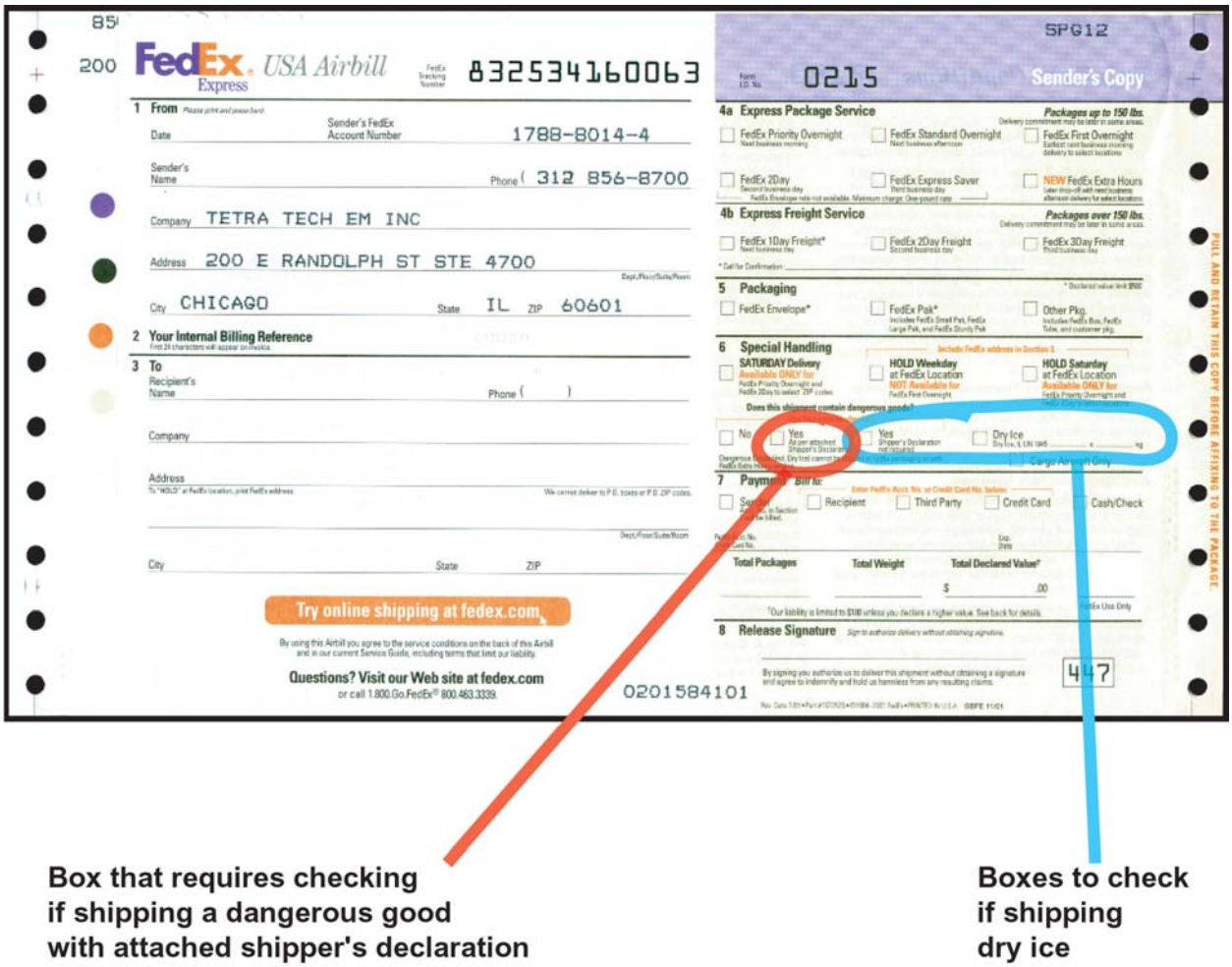
FIGURE 4

STANDARD FEDEX AIRBILL



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4.0 POTENTIAL PROBLEMS

The following problems may occur during dangerous goods shipment:

- **Leaking package:** If a leak occurs, the operator (see the definition in Section 2.0) may open the package and return it to the shipper. If dangerous goods are involved, the operator may inform the Federal Aviation Administration (FAA) of any improper packaging, which may result in fines.

- **Improper labeling and marking of package:** Mistakes made in labeling and marking a package will likely be noticed by the operator, who will then return the package to the shipper. Return of a package will delay its shipment by at least 1 day. Repeated mistakes will likely prompt the operator to inform the FAA.

- **Improper, misspelled, or missing information on the shipper's declaration:** The operator will likely notice erroneous or missing information on the shipper's declaration and return the package to the shipper as discussed above.

Shippers can contact FedEx at 1-800-463-3339 with questions about shipping dangerous goods.

5.0 REFERENCES

International Air Transport Association (IATA). 2001. *Dangerous Goods Regulations*. 42nd Edition.

U.S. Department of Transportation (DOT), Transport Canada, and the Secretariat of Communications and Transportation of Mexico. 2000. *2000 Emergency Response Guidebook*.

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TETRA TECH, INC.
HEALTH AND SAFETY MANUAL
VOLUME III

SAFE WORK PRACTICES (SWP)

FLAMMABLE HAZARDS AND IGNITION SOURCES

SWP NO.: 6-13

ISSUE DATE: JULY 1998

REVISION NO.: 1

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FLAMMABLE HAZARDS AND IGNITION SOURCES

This safe work practice (SWP) provides guidelines for handling flammable materials and controlling ignition sources in a manner that will prevent explosions and fires that may result in injuries. The guidelines also present procedures for proper flammable liquids transfer.

1.0 RESPONSIBILITIES

The project manager is responsible for ensuring that the work area is evaluated for the presence of flammable hazards and ignition sources and that all precautions provided in this SWP are implemented. The project manager is also responsible for ensuring that appropriate air monitoring procedures are defined in the site-specific health and safety plan (HASP). The site safety coordinator is responsible for recognizing potential flammable hazards and ignition sources, conducting air monitoring, posting warning signs, and notifying on-site workers of the hazards.

All field personnel must know that explosion and fires at a work site may result from any of the following:

- Chemical reaction
- Ignition of explosive or flammable materials
- Agitation of shock-sensitive compounds
- Sudden release of materials under pressure

Field personnel must also understand that each flammable gas and vapor has a minimum concentration in air below which propagation of flame does not occur on contact with an ignition source. This concentration is known as the lower explosive limit (LEL) and is expressed as a percent in air. Likewise, for every flammable gas and vapor, there is also a maximum concentration of gas or vapor in air above which propagation of flame does not occur. This value is known as the upper explosive limit (UEL) and is also expressed as a percent in air. The flammable range of a particular gas or vapor is the range between the LEL and UEL where the gas-air mixture will support combustion.

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Proper precautions must be taken to protect against fire and ignition hazards, including air monitoring, elimination of ignition sources, and proper chemical handling and transfer. These precautions are discussed below.

2.0 AIR MONITORING

Monitoring for flammable or explosive atmospheres is performed using a combustible gas indicator (CGI). This instrument is designed to provide data in terms of the percent LEL. Instructions on the model use, calibration, and operating procedures shall be incorporated into the site-specific HASP as appropriate.

Because flammable gases and vapors can be heavier or lighter than air, it is important to remember that the sampling probe should be moved slowly up and down at multiple levels when monitoring for gases. Response time varies between different meters, sensor types, sample hose lengths, and accessories used.

3.0 ELIMINATION OF IGNITION SOURCES

The risk of fires and explosions will be reduced when ignition sources are eliminated by using the following procedures:

- Ignition sources that are not required for the completion of the project should not be allowed in the exclusion zone or contamination reduction zone at hazardous waste sites or in the vicinity of work associated with flammable materials at any site.
- Warning signs should be posted and the work zone barricaded or blocked off before any work is conducted that might release flammable gases or vapors.
- All ignition sources should be eliminated from areas where flammable gases or vapors may be present or migrate to.
- If the wind direction may carry flammable gases or vapors into areas outside the work zone where ignition sources may be present, work should not be performed without careful monitoring of concentrations at the work zone boundary.
- Sparks caused by friction or electrostatic effects should be controlled using with proper grounding and bonding procedures for transfer of flammable liquids. This requires maintaining constant contact using metal between the containers and providing a metallic route to the ground to discharge electrostatic buildup.

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- Sparkless tools should be used.

4.0 PROPER CHEMICAL HANDLING AND TRANSFER

Precautions to reduce the risk of fire and explosion during chemical handling and transfer include the following:

- Liquids and residues should be removed from containers or tanks using explosion-proof or air-driven pumps.
- Pump motors and suction hoses should be bonded to the container or tank or otherwise grounded to prevent electrostatic ignition hazards.
- If a vacuum truck is used to remove liquids or residues, the area of operation for the vacuum truck should be vapor or gas free. The truck should be located upwind and outside of the path of probable gas or vapor travel. Vacuum pump exhaust gases should be discharged downwind of the truck through a hose of adequate size and length.
- After chemicals have been transferred, lines leading to the truck should be disconnected using nonsparking procedures and then the lines should be drained of their contents. Precautions should be taken to ensure that the contents of the lines do not spill into the environment during line disconnection.
- Only nonsparking or nonheat-producing tools should be used for opening containers and tanks. Electrical equipment shall also be explosion-proof.

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TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

SPILL AND DISCHARGE CONTROL PRACTICES

SWP NO.: 6-14

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SPILL AND DISCHARGE CONTROL PRACTICES

This safe work practice (SWP) provides contingency measures for spills and unintentional discharges from handling and transporting hazardous materials. Spill and discharge control practices should follow specific procedures to ensure the safety of responders and bystanders and to limit environmental impacts.

1.0 GENERAL PROCEDURES

Immediate action should be taken to control and contain any spill following the general guidelines below:

- Unnecessary people should be kept away from the spill or discharge.
- The hazardous area should be isolated.
- If the spill or discharge creates a hazardous situation or results in injury or an environmental release, the emergency procedures of the HASP should be implemented. Emergency response telephone numbers, designated contacts, and special reporting procedures are presented in the HASP.
- Personnel should stay on the upwind side of the spill or discharge.
- Entry into a confined space or low area where liquids or vapors may accumulate should be avoided.
- Sources of ignition should be eliminated if the spill or discharge involves combustible materials.
- Drains, manholes, waterways, sewers, and the like should be identified and covered or protected.
- The spill should be controlled or absorbed using appropriate media or devices.
- When the spill or discharge is fully contained and under control, spill or discharge material should be collected.
- Following cleanup, the spill area should be evaluated by collecting soil samples and screening the area with air monitoring instruments.

2.0 SOLIDS

If the spill or discharge material is solid and nonreactive, the material should be scooped up and placed in a suitable and compatible container until the disposal method has been determined.

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3.0 LIQUIDS

If liquid is discharged, the following general procedures apply:

- The point of discharge should be immediately identified and measures taken to eliminate further discharges by uprighting or patching containers, transferring contents, or other appropriate methods.
- Any discharged liquids or sludge should be removed or retrieved.
- Discharged materials should be cleaned up with absorbent materials or devices.
- Spent absorbent material should be placed into storage or disposal containers.

4.0 REPORTING

In some instances, a release may require reporting to government agencies. If a reportable quantity is released (this quantity is stated on the Material Safety Data Sheet) or human health or the environment is threatened, appropriate national, state, and local administering agency personnel should be notified. The timeframe for notification may vary from agency to agency. Notification may be required immediately or within 24 hours, depending on the type, location, and amount of released material. The appropriate agency to report spills to should be determined during HASP development.

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SAFE WORK PRACTICES (SWP)

HEAT STRESS

SWP NO.: 6-15

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HEAT STRESS

This safe work practice (SWP) describes situations where heat stress is likely to occur and provides procedures for the prevention and treatment of heat-related injuries and illnesses. Wearing personal protective equipment (PPE), especially during warm weather, puts employees at considerable risk of developing heat-related illnesses. Health effects from heat stress may range from transient heat fatigue or rashes to serious illness or death.

Many factors contribute to heat stress, including PPE, ambient temperature and humidity, workload, and the physical condition of the employee, as well as predisposing medical conditions. However, the primary factors are elevated ambient temperatures in combination with fluid loss. Because heat stress is one of the more common health concerns that may be encountered during field activities, employees must be familiar with the signs, symptoms, and various treatment methods of each form of heat stress. Heat stroke is the most serious heat-related illness—it is a threat to life and has a 20 percent mortality rate. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age directly affect the tendency to heat stroke. Table 1 lists the most serious heat conditions, their causes, signs and symptoms, and treatment.

Training is an important component of heat stress prevention. Employees are instructed to recognize and treat heat-related illnesses during 8-hour health and safety refresher and first aid training courses. When working in hot environments, specific steps should be taken to lessen the chances of heat-related illnesses. These include the following:

- Ensuring that all employees drink plenty of fluids (Gatorade® or its equivalent)
- Ensuring that frequent breaks are scheduled so overheating does not occur
- Revising work schedules, when necessary, to take advantage of the cooler parts of the day (such as working from 5:00 a.m. to 11:00 a.m. and 6:00 p.m. to nightfall).

When PPE must be worn (especially Levels A and B), suggested guidelines relating to ambient temperature and maximum wearing time per excursion are as shown in Table 2.

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TABLE 1

HEAT STRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Heat cramps	Fluid loss and electrolyte imbalance from dehydration	• Painful muscle cramps, especially in legs and abdomen • Faintness • Profuse perspiration	• Move affected worker to cool location • Provide sips of liquid such as Gatorade® • Stretch cramped muscles • Transport affected worker to hospital if condition worsens
Heat Exhaustion	Blood transport to skin to dissipate excessive body heat, resulting in blood pooling in the skin with inadequate return to the heart	• Weak pulse • Rapid and shallow breathing • General weakness • Pale, clammy skin • Profuse perspiration • Dizziness • Unconsciousness	• Move affected worker to cool area • Remove as much clothing as possible • Provide sips of cool liquid or Gatorade® (only if conscious) • Fan the person but do not overcool or chill • Treat for shock • Transport to hospital if condition worsens
Heat Stroke	Life threatening condition from profound disturbance of body's heat-regulating mechanism	• Dry, hot, and flushed skin • Constricted pupils • Early loss of consciousness • Rapid pulse • Deep breathing at first, and then shallow breathing • Muscle twitching leading to convulsions • Body temperature reaching 105 or 106 °F or higher	• Immediately transport victim to medical facility • Move victim to cool area • Remove as much clothing as possible • Reduce body heat promptly by dousing with water or wrapping in wet cloth • Place ice packs under arms, around neck, at ankles, and wherever blood vessels are close to skin surface • Protect patient during convulsions

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TABLE 2

SUGGESTED GUIDELINES WHEN WEARING PPE

Ambient Temperature	Maximum PPE Wearing Time per Excursion
Above 90 °F	15 minutes
85 to 90 °F	30 minutes
80 to 85 °F	60 minutes
70 to 80 °F	90 minutes
60 to 70 °F	120 minutes
50 to 60 °F	180 minutes

Source: National Institute for Occupational Safety and Health (NIOSH). 1985. Memorandum Regarding Recommended Personal Protective Equipment Wearing Times at Different Temperatures. From Austin Henschel. To Sheldon Rabinovitz. June 20.

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To monitor the level of an employee's heat stress, the following should be measured:

- Heart Rate: Count the radial (wrist) pulse during a 30-second period as early as possible in the rest period; if heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next period, shorten the following work cycle by one-third.

- Oral Temperature: Use a clinical thermometer (3 minutes under the tongue) to measure the oral temperature at the end of the work period. If oral temperature exceeds 99.6 °F (37.6 °C), shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6 °F at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear impermeable PPE when his or her oral temperature exceeds 100.6 °F (38.1 °C).

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HEALTH AND SAFETY MANUAL
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SAFE WORK PRACTICES (SWP)

COLD STRESS

SWP NO.: 6-16

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COLD STRESS

This safe work practices (SWP) describes situations where cold stress is likely to occur and discusses procedures for the prevention and treatment of cold-related injuries and illnesses. Cold conditions may present health risks to employees during field activities. The two primary factors that influence the risk potential for cold stress are temperature and wind velocity. Wetness can also contribute to cold stress. Other factors that increase susceptibility to cold stress include age (very young or old), smoking, alcohol consumption, fatigue, and wet clothing. Hypothermia can occur at temperatures above freezing if the individual has on wet or damp clothing or is immersed in cold water. The combined effect of temperature and wind can be evaluated using a wind chill index as shown in Table 1.

Bare flesh and body extremities that have high surface area-to-volume ratios such as fingers, toes, and ears are most susceptible to wind chill or extremely low ambient temperatures. Because cold stress can create the potential for serious injury or death, employees must be familiar with the signs and symptoms and various treatments for each form of cold stress. Table 2 provides information on frostbite and hypothermia, the two most common forms of cold-related injuries.

Training is an essential component of cold stress prevention. Employees are instructed to recognize and treat cold-related injuries during 8-hour health and safety refresher and first aid training courses. When working in cold environments, specific steps should be taken to lessen the chances of cold-related injuries. These include the following:

- Protecting of exposed skin surfaces with appropriate clothing (such as face masks, handwear, and footwear) that insulates, stays dry, and blocks wind
- Shielding the work area with windbreaks to reduce the cooling effects of wind
- Providing equipment for keeping workers' hands warm by including warm air jets and radiant heaters in addition to insulated gloves
- Using adequate insulating clothing to maintain a body core temperature of above 36 °C
- Providing extra insulating clothing on site

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TABLE 1

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE

Estimated Wind Speed (in miles per hour - mph)	**Actual Temperature Reading (°F)**											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
CALM	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* in less than 1 hour with dry skin; maximum danger from false sense of security				*INCREASING DANGER* from freezing of exposed flesh within 1 minute				*GREAT DANGER* that flesh may freeze within 30 seconds			
	Trench foot may occur at any point on this chart.											

Source: Modified from American Conference of Governmental Industrial Hygienists. 1997. "Threshold Limit Values for Chemical Substances and Physical Agents."

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TABLE 2

COLD STRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Frostbite	Freezing of body tissue, usually the nose, ears, chin, cheeks, fingers, or toes	• Pain in affected area that later goes away • Area feels cold and numb • Incipient frostbite (frostnip) - skin is blanched or whitened and feels hard on the surface • Moderate frostbite - large blisters • Deep frostbite - tissues are cold, pale, and hard	• Move affected worker to a warm area • Immerse affected body part in warm (100 to 105 °F) water—not hot! • Handle affected area gently; do not rub • After warming, bandage loosely and seek immediate medical treatment
Hypothermia	Exposure to freezing or rapidly dropping temperatures	• Shivering, dizziness, numbness, weakness, impaired judgment, and impaired vision • Apathy, listlessness, or sleepiness • Loss of consciousness • Decreased pulse and breathing rates • Death	• Immediately move affected person to warm area • Remove all wet clothing and redress with loose, dry clothes • Provide warm, sweet drinks or soup (only if conscious) • Seek immediate medical treatment

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- Reducing the duration of exposure to cold
- Changing wet or damp clothing as soon as possible

During periods of extreme cold (10 °F or less) workers should use the buddy system to ensure constant protective observation.

Specific monitoring criteria are not established for cold stress. However, employees should be thoroughly cognizant of the signs and symptoms of frostbite and hypothermia (see Table 1) in themselves as well as in coworkers. All instances of cold stress should be reported to the site safety coordinator. Work schedules may be adjusted and warm-up regimes imposed as needed to deal with temperature and wind conditions.

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TETRA TECH, INC.
HEALTH AND SAFETY MANUAL
VOLUME III

SAFE WORK PRACTICES (SWP)

BIOHAZARDS

SWP NO.: 6-17

ISSUE DATE: JULY 1998

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BIOHAZARDS

Biological hazards, or "biohazards," include plants, animals or their products, and parasitic or infectious agents that may present potential risks to worker health. This safe work practice (SWP) discusses procedures for working with biohazards, preventive guidelines, and first-aid procedures for the most common hazards field staff are likely to encounter. This SWP does not address biohazards such as those associated with medical waste. Procedures for working with this type of biohazard should be addressed in the site-specific health and safety plan (HASP) on a case-by-case basis.

During preparation of the site-specific HASP, the preparer should consider which plants, animals, and other biological agents may be encountered; assess their potential risk to project personnel; and attach this SWP to the HASP, if necessary. Office health and safety representatives should become familiar with biological hazards indigenous to the geographical area in which most of their office personnel work and assist in evaluating the risks to personnel on projects staffed from their offices. SWPs for insects, snakes, animals, plants, waterborne pathogens (giardia), and hantavirus are provided below.

1.0 INSECTS

SWPs for reducing the chance of insect bites or stings and for treating bites or stings are listed below.

- Workers should keep as much skin area covered as possible by wearing long-sleeved shirts, long pants, and a hat. Pant legs should be tucked into socks or boots and shirts into pants. In addition, workers should wear light colored clothing.
- A proven insect repellent should be used on bare skin and clothing.
- When possible, tall grasses and brush that could harbor ticks should be avoided.
- Several times during the day and at the end of the work day, each worker should perform a check for evidence of imbedded ticks or previous bites. Particular attention should be paid to the scalp, neck, ankles, back of the legs, and waist.
- When opening well covers, vaults, or other closed items, workers should watch for hornet or wasp nests and black widow or brown recluse spiders. Workers should never reach into spaces with unprotected arms.
- Workers should watch carefully for bees around open soft drinks or food.

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- If a worker is stung by a bee, the stinger should be carefully removed, if present. The wound should be washed and a cold pack applied. Allergic reaction should be watched for and is evidenced by extreme swelling, redness, pain, or difficulty breathing.

- If a worker is stung or bit by a spider or scorpion, medical attention should be obtained immediately.

2.0 SNAKES

SWPs for encounters with snakes and for treating snakebites are listed below.

- Workers should avoid walking in areas known to harbor snakes. Workers should be cautious when picking up or moving items that have been on the ground.

- Workers should wear boots made of heavy material that protect the ankles and pants. Heavy work gloves should be worn for picking up items.

- If one snake is encountered, others may be present. Workers should leave the area by retracing their steps.

- If a worker is bitten, the wound should be washed and the injured area immobilized and kept lower than the heart, if possible. Ice or a tourniquet should not be applied to a snake bite. The wound should not be cut. If medical care is more than 30 minutes away from a work site, a snakebite kit should be available on site and workers should know how to use it.

3.0 ANIMALS

SWPs for encounters with animals and for treating associated wounds are listed below.

- If workers encounter a wild animal, the animal should be observed for unusual behavior such as a nocturnal animal out during the day, drooling, an appearance of partial paralysis, irritability, meanness, or a strangely quiet demeanor.

- Workers should never touch the body of a dead animal because certain diseases could be carried by fleas still on the body.

- Workers should avoid animal droppings (including bird droppings). Pathogens, some of which can become airborne, may still be present in the droppings.

- If a worker is bitten, he or she should get away from the animal to avoid further bites. Workers should not try to stop, hold, or catch the animal.

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- If the wound is minor, it should be washed with soap and water. Any bleeding should then be controlled, and an antibiotic ointment and dressing should be applied. All animal bite wounds should be watched for signs of infection.

- If the wound is bleeding seriously, the bleeding should be controlled but the wound should not be cleaned. Medical assistance should be summoned immediately.

- If a rabid animal is suspected, immediate medical attention should be summoned. If possible, workers should try to remember what the rabid animal looked like and the area in which it was last seen. The animal should be reported by calling the local emergency number.

4.0 PLANTS

SWPs for plants are as follows:

- Workers should be aware of the types and appearances of poisonous plants in the work site area. Poison ivy, oak, and sumac are the most frequently encountered plants that can cause reaction from casual contact. If a worker is extremely sensitive to these plants, he or she should avoid the area entirely because airborne drift could be sufficient to cause a reaction. Other plants, such as fireweed, can cause painful, short-term irritation and should be avoided as well. Workers should avoid touching face and eye areas after contact with any suspicious plant.

- Workers should wear proper clothing if working in or near overgrown areas. Disposable outerwear should be used, if necessary, and workers should not touch the material with bare hands during removal if the outerwear may have contacted poisonous plants.

- If contact with a poisonous plant has occurred, the affected area should be immediately washed thoroughly with soap and water. If a rash or weeping sore has already begun to develop, a paste of baking soda and water should be applied to the area several times a day to reduce discomfort. Lotions such as Calamine or Caladryl should be applied to help soothe the area. If the condition gets worse and affects large areas of the body or the face, a doctor should be consulted.

- Bushy and wooded areas should be thoroughly checked for thorn-bearing trees, brush, and bramble. In some cases, impalement can cause severe pain or infection.

5.0 WATERBORNE PATHOGENS-GIARDIA

Giardia is a waterborne pathogen consisting of a protoplasmic parasite of the mammalian digestive tract. Giardia is present worldwide, with the highest occurrence in areas with poor sanitation. In the United

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States, most reported cases are in mountainous regions where drinking water is obtained from streams and is unfiltered or untreated.

Giardia is contracted by ingesting water contaminated with giardia cysts in the dormant state. Giardia parasites can only thrive in the digestive tracts of mammals. Dormant giardia organisms enter water through the feces of infected animals or humans. Giardia symptoms include severe diarrhea and upset stomach. Some people are asymptomatic but can transmit the disease to others. Medical treatment of giardia can be difficult and unpleasant; therefore, prevention is critical. Precautions for preventing exposure to giardia are listed below.

- Workers should assume that all fresh water streams are infected with the giardia organism and not drink any untreated water.
- Team members collecting sediment and water samples from streams should wash their hands thoroughly with soap and water after collecting the samples.
- Giardia parasites are relatively easy to destroy or filter. Water should be treated for drinking or cooking with iodine or another recommended giardia treatment before use.

6.0 HANTAVIRUS

Hantavirus pulmonary syndrome (HPS) is a potentially fatal infection caused by a rodent-borne hantavirus. HPS begins with a brief illness most commonly characterized by fever, muscle pain, headache, coughing, and nausea or vomiting. Other early symptoms include chills, diarrhea, shortness of breath, abdominal pain, and dizziness. In the first identified cases of HPS, this stage of the infection lasted 2 to 5 days before victims were hospitalized. Typically, by the time of hospitalization, victims were found to have tachycardia (a heart rate of greater than 100 beats per minute) and tachypnea (a breathing rate of greater than 20 breaths per minute). Fever was also common. In most cases, death occurred within 2 to 16 days of the onset of symptoms, and victims exhibited pulmonary edema and severe hypotension.

Currently, experts believe that HPS is spread by the deer mouse (*Peromyscus maniculatus*). Though the deer mouse has been found to be the primary host of hantavirus, several other rodent species have also tested positive for the virus. Pinon mice (*Peromyscus truei*), brush mice (*Peromyscus boylii*), and western

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chipmunks (*Tamia spp.*) are also likely to carry the virus. Also, cases of HPS have been reported in areas of the United States where these particular rodents are not indigenous.

Infected rodents shed the virus in their urine, feces, and saliva. Humans can be exposed to the virus through (1) inhalation of suspended rodent excreta or dust particles containing rodent excreta, (2) introduction of rodent excreta into the eyes or broken skin, and (3) ingestion of food or water contaminated by rodent excreta. HPS has a reported mortality rate of 55 percent. Transmission of hantavirus from infected individuals to healthy persons has not been documented.

Prevention of HPS infection is essential because no known antidote and no specific treatment exists for treating HPS. Therefore, employees should practice risk reduction and control measures. Guidelines for workers in locations that may have rodent infestations or habitats are listed below.

- The best approach for HPS control and prevention is through environmental hygiene practices that deter rodents from colonizing the work environment.
- Information about the symptoms of HPS and detailed guidance on preventive measures should be provided to all employees assigned to field activities.
- Medical attention should be sought immediately for workers who develop a febrile or respiratory illness within 45 days of the last potential exposure to rodents. Attending physicians should be advised of each worker's potential for occupational exposure to hantavirus. Physicians should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained from the affected worker and forwarded with the baseline serum sample through the state health department to the Centers for Disease Control and Prevention for hantavirus antibody testing.
- Respiratory protective equipment should be worn when handling rodents, when removing rodents from traps, and when working in areas with evidence of rodent droppings or hair. Respiratory protective equipment should include, at a minimum, a half-face air-purifying respirator (APR) or powered APR equipped with a high-efficiency particulate air (HEPA) filter (P100). Full-face regulators may be needed under some circumstances. Respiratory protective equipment should be used in accordance with Occupational Safety and Health Administration regulations.
- Dermal protection should be worn when handling rodents or traps containing rodents, or if contact with contaminated surfaces could occur. Dermal protection should include rubber or plastic gloves that should be washed and disinfected before removal.

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- A trap contaminated with rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or a 0.4 percent bleach solution. A dead rodent should be disposed of by placing the carcass in a plastic bag containing enough general-purpose household disinfectant to thoroughly wet the carcass. The bag should be sealed and disposed of by burning or by burying it in a 2- to 3-foot-deep hole. Local and state health departments can also provide appropriate disposal methods.

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TETRA TECH, INC.
HEALTH AND SAFETY MANUAL
VOLUME III

SAFE WORK PRACTICES (SWP)

RADIATION SAFETY PRACTICES

SWP NO.: 6-21

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Disclaimer: This safe work practice (SWP) is the property of Tetra Tech, Inc. (Tetra Tech), and its subsidiaries. Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

RADIATION SAFETY PRACTICES

This safe work practice (SWP) applies to employees who work at sites where ionizing radiation (radiation) is a known or suspected hazard. This SWP applies to ionizing forms of radiation only and does not address hazards or SWPs for nonionizing forms of radiation such as infrared, ultraviolet, microwave, radio waves, and so on. This SWP addresses the requirements of Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.96, "Ionizing Radiation," and the requirements of 10 CFR, Part 20, "Standards for Protection Against Radiation" (applicable to environmental consultants and engineers). Health and safety plans (HASP) for work sites with known or suspected ionizing radiation shall include this SWP as an attachment. General guidelines, exposure limits, and procedures are discussed below.

1.0 GENERAL GUIDELINES

Tetra Tech, Inc. (Tetra Tech), intends to keep all employee radiation exposure levels as low as reasonably achievable (ALARA). Field workers should use a combination of engineering controls, administrative controls, and personal protective equipment (PPE) to limit external and internal radiation doses. Basic protection control measures that apply to all forms of radiation include (1) reducing exposure time, (2) increasing distance from the radiation source, and (3) using a shield between the radiation source and employees. Additional guidelines are listed below.

- Employees less than 18 years of age shall not be allowed to work in areas with known or suspected radiation hazards.
- Personnel will be protected from internal and external radiation exposure hazards through general and site-specific training, use of PPE, adherence to strict work practices, and proper decontamination procedures.
- Ingestion of contaminated material will be prevented through good personal hygiene.
- Eating, drinking, and smoking are <u>not</u> permitted in potentially contaminated areas.
- Washing hands when leaving a contaminated area and before eating is required.
- Employees with open cuts or abrasions are <u>not</u> allowed to handle contaminated material because handling may allow entry of the material into the bloodstream.
- Pregnant employees will be advised not to work in areas with known or suspected radiation hazards. However, if a pregnant woman wants to work, limits on declared pregnant workers defined in 10 CFR, Part 20 apply.

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The site safety coordinator (SSC) is responsible for ensuring that personnel are appropriately monitored for exposure to ionizing radiation. A radiation protection officer (RPO) may be assigned to a site to assist the SSC.

2.0 EXPOSURE LIMITS

Ionizing radiation presents a hazard as both a source of external exposure and as a contaminant of surfaces and media. Radiation exposure limits as established by the Nuclear Regulatory Commission (NRC) are presented below.

Type of Exposure	Annual Limit
Whole body (head and trunk), active blood-forming organs, or gonads	5 roentgen equivalent in man (rem) per year, total effective dose
Lens of the eye	15 rem per year
Extremities	50 rem per year
Skin of the whole body	50 rem per year

In addition to the whole-body doses listed above, the NRC has also established derived air concentrations (DAC) for airborne radioactive materials (RAM) exposures. Table 1 of Appendix B, 10 CFR, Part 20, lists DACs for RAMs. The DAC values are designed to maintain internal exposure doses below the annual limit for intake (ALI), assuming a 40-hour per week exposure period. Total body dose calculations must factor in the contribution of airborne RAM to the total dose. The table in 10 CFR, Part 20, should be consulted when calculating internal exposures through inhalation of specific radionuclides.

3.0 PROCEDURES

The following sections discuss procedures related to personal monitoring, environmental monitoring, restricted areas, training, PPE, decontamination, and exposure and medical records associated with work at sites involving potential exposure to radiation.

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3.1 PERSONAL MONITORING

Each individual working at a site with the potential for radiation exposure will participate in a monitoring program designed to measure worker external and internal radiation doses. The instrument and devices used for this monitoring as well as monitoring procedures and protocol are discussed below.

3.1.1 External Radiation Dosimetry

External radiation exposure can be measured by thermoluminescent dosimeters (TLD), film badges, and pocket dosimeters. The determination of the appropriate dosimeter for a specific project will be made based on site history and potential risk for exposure to external ionizing radiation. Specific badge handling procedures will be provided on a case-by-case basis.

TLDs that measure x-ray, beta, and gamma radiation are general use dosimeters that measure external ionizing radiation levels to which personnel are exposed. At some work locations, a TLD that also detects fast neutron radiation will be used. The TLDs are analyzed after each calendar quarter to comply with Occupational Safety and Health Administration (OSHA) and NRC requirements. Tetra Tech shall provide TLDs to field workers who routinely work in areas with potential radiation hazards. TLD badges should be ordered from a reputable dosimetry vendor. All personal dosimeters must be worn on the front of the body between the neck and waist. TLDs must be worn outside of any protective clothing. Dosimeters should be protected from inclement weather conditions.

If TLDs are needed for long-term projects lasting more than 5 months, a full TLD program should be set up with a vendor. Employee names, social security numbers, birth dates, and genders must be supplied to the vendor to establish a quarterly monitoring program. At the end of each monitoring period, all TLDs and a control TLD must be returned to the vendor for analysis. The official and permanent record of the cumulative external dose received by each employee is obtained from the quarterly interpretations of the TLD. Billing and exposure reports will be managed by the regional health and safety representative (RHSR) or subsidiary health and safety representative (SHSR). The RHSR or SHSR must be contacted to add employees to the radiation dosimetry program.

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Under certain circumstances, Tetra Tech may allow use of film badges rather than TLDs. Film badges are used to measure external exposure to x-ray and gamma radiation. Film badges are typically analyzed on a monthly basis. Placement and use of film badges is similar to those for TLDs.

Employees scheduled for short-term field work where potential radiation hazards exist should use pocket dosimeters. Pocket dosimeters should be used for field work lasting 1 to 2 days. Pocket dosimeters can be used along with TLDs to provide real-time exposure monitoring. Employees using a pocket dosimeter in areas exceeding the applicable radiation exposure action levels must record the radiation dose daily in a field logbook. A copy of recorded exposures above background levels must be submitted to the RHSR or SHSR within 15 calendar days of field work completion. If the pocket dosimeter indicates that an individual has received a radiation dose of 100 millirems or more, the individual will be removed from field work and his or her TLD will be processed immediately. Pocket dosimeters must be requested through the Tetra Tech equipment vendor.

In the event of a lost or damaged TLD, the site RPO or SSC will determine a dose estimate for the individual by using values recorded on direct-reading instruments. If such a dose cannot be determined, the maximum permissible radiation dose for the time period in question for the affected employee will be recorded in the field logbook.

3.1.2 Airborne Radioactive Material Measurement

Airborne RAM may enter the body during inhalation resulting in an internal radiation dose. NRC regulations require the measurement of airborne RAM concentrations whenever inhalation exposures may result in an intake in excess of 10 percent of the ALI for that RAM as defined in Appendix B, Table 1, of 10 CFR, Part 20. In accordance with principles of ALARA, Tetra Tech shall require monitoring of airborne RAM under all circumstances of potential exposure.

Airborne RAM may be emmitted by processes involving RAM or from radioactive contamination in dirt, debris, and on surfaces that have been disturbed. Monitoring shall be conducted using air sampling devices appropriate for personal monitoring and shall account for all potential periods of exposure. Samples shall be submitted to an accredited laboratory for analysis as soon as possible.

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3.2 ENVIRONMENTAL MONITORING

The types of radiation sources, RAM, and types and extent of impacts to the site (such as surficial contamination), will determine which survey instruments are necessary to characterize the site. Both area radiation levels and surface contamination levels will be monitored. Survey instruments will be specified in the HASP. Tetra Tech can obtain the necessary radiation survey instruments for area monitoring through equipment vendors.

During initial site entry, personnel will monitor site conditions with direct-reading instruments when site information is sufficient to show that the potential for ionizing radiation exposure exists or when specific site information is not sufficient to eliminate the possibility of radiation sources or contamination. The initial site evaluation will include a review of available site data, including site history.

Upon startup of field activities, regular monitoring will be conducted if necessary to track the locations and intensities of RAM. Monitoring of airborne RAM within work areas and at the site's downwind perimeters is also required.

Results of radiation and contamination surveys shall be documented in the field logbook and the logbook shall remain on site for the duration of site activities. As work progresses at the site, survey and contamination maps shall be updated accordingly.

3.3 RESTRICTED AREAS

Restricted areas are designated to control personnel exposures to RAM and to prevent the spread of contamination out of the area. The posting of warning signs around restricted areas shall follow the requirements of 10 CFR, Part 20, Subpart J. Restricted areas shall be designated in the HASP as the exclusion zone or a portion of the exclusion zone.

3.4 TRAINING

Specific training requirements for work assignments involving potential exposure to RAM or radioactive contamination should be included in the site-specific HASP. Training requirements are not specified in 10 CFR, Part 20. However, Tetra Tech will require employees working with or potentially exposed to

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RAM to receive specific training on RAM and the hazards associated with the specific site. General RAM training will include the following topics:

- Types and properties of ionizing radiation
- Acute and long-term health effects of exposure to ionizing radiation
- Exposure routes
- PPE for RAM
- Administrative and engineering exposure controls
- Personal, area, and contamination monitoring devices and their uses
- Basic requirements of 10 CFR, Parts 19 and 20

Site-specific training will address the following topics:

- Types of RAM and ionizing radiation at the site
- Locations of RAM at the site
- Designated restricted and contaminated areas
- Decontamination methods
- Personal, area, and contamination monitoring devices designated for the site
- Emergency procedures for RAM incidents

3.5 PERSONAL PROTECTIVE EQUIPMENT

A minimum of full Level C protection with disposable coveralls must be worn in any potentially radiation-contaminated area. Tetra Tech personnel will use full face air purifying respirators with high-efficiency particulate air (P100) cartridges to prevent inhalation of airborne alpha particles and radionuclides. This level of protection will prevent or minimize radioactive material from contacting skin. PPE must be thoroughly decontaminated with extreme care to prevent the spread of contamination to other areas. Contaminated material on the skin must be removed as quickly as possible. Supplied air respirators can also be used depending on the hazard and work activity.

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3.6 DECONTAMINATION

Generally, decontamination procedures for RAM are the same as for hazardous waste (see Document Control No. 3-8, "Decontamination Program," in Volume II). However, employees should take the following additional precautions:

- Minimize the spread of contamination by following SWPs
- Know where contamination is and avoid tracking equipment and personnel through it
- Use proper decontamination techniques
- Use straight detergent, soap and water, or commercially prepared solutions to remove RAM (solutions containing ethylenediamine tetraacetic acid, such as Radiacwash®, will bind up RAM and maintain the RAM in solution before rinsing)
- Consider all decontamination materials to be contaminated; decontamination waste will contain RAM and must be disposed of properly

3.7 EXPOSURE AND MEDICAL RECORDS

Tetra Tech shall maintain records of radiation exposure of all employees for whom personnel monitoring was conducted. Records will be evaluated to verify that exposures are maintained at ALARA levels. Tetra Tech is obligated to evaluate ionizing radiation exposure data to verify that exposures are maintained at ALARA levels and will provide a yearly summary exposure report to each participating employee. Tetra Tech will notify each employee who has worn a dosimeter during the year of his or her annual exposure in February of the following year. If quarterly results indicate high exposure, the employee will be notified immediately. Retained radiation exposure records will indicate exposure in millirems per calendar quarter, DAC hours of airborne radiation exposure, and the calculated combined dose for the total body (summary of the external and internal doses) using methods for calculating total body dose presented in 10 CFR, Part 20.1202.

Special medical examinations may be necessary when excessive external or internal doses of radioactive materials are suspected to have occurred. Medical evaluation needs will be established on a case-by-case basis with the advice of the Tetra Tech consulting physician. Any instance of suspected overexposure should be reported immediately to the SSC. The SSC will contact the appropriate RHSR or SHSR for recommendations on how to proceed with follow-up medical evaluations.

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Tetra Tech shall maintain exposure records for former employees along with their medical records as stated in Document Control No. 1-4, "Recordkeeping and Reporting Program," in Volume I and Document Control No. 3-2, "Medical Surveillance Program," in Volume II. These records will be available to former employees within 30 days of receipt of a written request for them.

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TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

USE OF HEAVY EQUIPMENT

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USE OF HEAVY EQUIPMENT

Truck-mounted heavy equipment and field trucks are among the types of equipment that may be used during field work. Heavy equipment can present a substantial hazard to workers. General requirements for motor vehicles and material-handling equipment are provided in the Occupational Safety and Health Administration (OSHA) Construction Industry Standards, 29 CFR 1926, Subpart O. The following precautions will be followed when heavy equipment (such as drill rigs, front-end loaders, and backhoes) is in use:

- Heavy equipment will be inspected by the operator before each work shift. The site safety coordinator (SSC) will ensure compliance with these precautions
- Equipment operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC
- Only qualified and licensed personnel will operate heavy equipment
- Hard hats, steel-toed boots, and safety glasses or goggles will be worn at all times around heavy equipment. Other personal protective equipment (PPE) specified in the site health and safety plan (HASP) will also be required
- Workers will not assume that the equipment operator is keeping track of their exact location. Workers will never walk directly behind or to the side of heavy equipment without the operator's knowledge
- Workers in close proximity to heavy equipment will maintain visual contact with equipment operators at all times
- When an operator must maneuver equipment in tight quarters, the presence of a second person will be required to ensure adequate clearance. If backing is required, two ground guides will be used—one in the direction the equipment is moving, and the other in the operators's normal field of vision to relay signals
- All heavy equipment used at a contaminated work site will be kept in the exclusion zone until the work has been completed. Such equipment will then be decontaminated within the designated decontamination area
- Hand-signal communications will be established when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators
- Equipment with an obstructed rear view must have an audible alarm that sounds when the equipment is moving in reverse (unless a spotter guides the operator)

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- Parking brakes will be kept engaged when equipment is not in use
- Blades, buckets, dump bodies, and other hydraulic systems will be kept fully lowered when equipment is not in use
- Equipment cabs will be kept free of all nonessential and loose items
- Seat belts must be present in all vehicles having a rollover protective structure (ROPS)
- With certain exceptions, all material-handling equipment must be equipped with ROPS
- Material-handling equipment that lacks a ROPS will not be operated on a grade unless the grade can safely accommodate the equipment involved
- Drilling auger sections and other equipment are extremely heavy. All precautions must be taken before moving heavy equipment. Appropriate equipment must be used to transport heavy equipment
- Only chains, hoists, straps, and other equipment that safely aids transport of heavy materials will be used
- Proper personal lifting techniques will be used. Workers will lift using their legs, not their backs
- A safety barrier will be used to protect workers when tires are inflated, removed, or installed on split rims
- An ongoing maintenance program for all tools and equipment must be in place. All tools and moving equipment will be inspected regularly to ensure that parts are secured, are intact, and have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate according to manufacturer specifications. Defective items will be promptly repaired or replaced. Maintenance and repair logs will be kept
- Tools will be stored in clean, secure areas to prevent damage, loss, or theft
- Workers will not use equipment with which they are not familiar. This precaution applies to heavy as well as light equipment
- Loose-fitting clothing and loose, long hair will be prohibited around moving machinery
- Workers will make sure that no underground or overhead power lines, sewer lines, gas lines, or telephone lines present a hazard in the work area
- All personnel who are not essential to work activities will be kept out of the work area

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- Workers will be aware of their footing at all times
- Workers will remain alert at all times

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TETRA TECH, INC.
HEALTH AND SAFETY MANUAL
VOLUME III

SAFE WORK PRACTICES (SWP)

RESPIRATOR CLEANING PROCEDURES

SWP NO.: 6-27

ISSUE DATE: FEBRUARY 1999

REVISION: 0

Disclaimer: This safe work practice (SWP) is the property of Tetra Tech, Inc. (Tetra Tech), and its subsidiaries. Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

RESPIRATOR CLEANING PROCEDURES

This safe work practice (SWP) provides guidelines for proper and thorough cleaning of respiratory protection equipment. The Occupational Safety and Health Administration (OSHA) regulates the use of respiratory protection for general industry in Title 29 of the *Code of Federal Regulations* (CFR) Part 1910.134, "Respiratory Protection." Appendix B-2 of the standard outlines mandatory requirements for respirator cleaning and is used as the basis for this SWP. This SWP supplements Document Control No. 2-6, "Respiratory Protection Program." It provides specific respirator cleaning and disinfection procedures and shall be included as an attachment to the site-specific health and safety plan for projects for which respirator use is planned or is a contingency.

1.0 APPLICABILITY

This SWP shall apply to any project that involves use of respirators with reusable facepieces.

Respirators shall be cleaned and disinfected as discussed below.

- Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.
- Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals.
- Respirators maintained for emergency use shall be cleaned and disinfected after each use.
- Respirators used in fit testing and training shall be cleaned and disinfected after each use.

2.0 CLEANING AND DISINFECTION PROCEDURES

Mandatory respirator cleaning procedures as defined in 29 CFR Part 1910.134, Appendix B-2, are listed below. All wash and rinse water should be warm, with a maximum temperature of 110 °F (43 °C).

1. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, and any other components as recommended by the manufacturer. Discard or repair any defective parts.

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2. Wash components in warm water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

3. Rinse components thoroughly in clean, warm, preferably running water. Drain all components.

4. When the cleaner does not contain a disinfecting agent, respirator components should be immersed for 2 minutes in one of the following:

   - Hypochlorite solution [50 parts per million (ppm) of chlorine] made by adding approximately one milliliter of laundry bleach to 1 liter of warm water

   - Aqueous solution of iodine [50 ppm iodine made by adding approximately 0.8 milliliter of tincture of iodine (6 to 8 grams ammonium and/or potassium iodide per 100 cubic centimeters of 45 percent alcohol) to 1 liter of warm water]

   - Other commercially available cleansers of equivalent disinfectant quality when used as directed if their use is recommended or approved by the respirator manufacturer

5. Rinse components thoroughly in clean, warm, preferably running water. Drain all components. The importance of thorough rinsing cannot be over emphasized. Detergents or disinfectants that dry on facepieces may cause dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

6. Components should be air-dried or hand-dried with a clean, lint-free cloth.

7. Reassemble the facepiece. Replace filters, cartridges, and canisters prior to next use.

8. Test the respirator to ensure that all components work properly.

9. Place the respirator in a clean bag and seal for storage.

Depending on work conditions, respirator facial sealing surfaces may need periodic cleaning during the course of daily use. Cleaning of the facial sealing surface during work breaks can reduce the chance of facial irritation caused by sweat, natural skin oil, or irritating materials that may have deposited on the facepiece. Facial sealing surfaces can be cleaned using disinfectant wipes soaked in isopropyl alcohol or benzalkonium chloride. After use of the disinfectant wipe, the sealing surface should air dry or be dried thoroughly using paper towels or tissues.

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TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

SAFE WORK PRACTICES FOR USE OF AIR PURIFYING RESPIRATORS

SWP NO.: 6-28

ISSUE DATE: FEBRUARY 1999

REVISION: 0

Disclaimer: This safe work practice (SWP) is the property of Tetra Tech, Inc. (Tetra Tech), and its subsidiaries. Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

SAFE WORK PRACTICES FOR USE OF RESPIRATORS

This safe work practice (SWP) was developed to ensure the proper use of respirators in routine and foreseeable emergency situations. The SWP supplements Document Control No. 2-6, "Respiratory Protection Program." This SWP shall be included as an attachment to the site-specific health and safety plan (HASP) for projects for which respirator use is planned or is a contingency.

1.0 APPLICABILITY

This SWP shall apply to any project that involves use of air purifying respirators and shall not be used for situations involving the use of supplied air systems such as self-contained breathing apparatuses and air-line apparatuses.

2.0 ROUTINE RESPIRATOR USE PROCEDURES

The procedures below apply to the routine use of air purifying respirators.

- Respirators shall not be issued to or worn by individuals when conditions prevent valve function or a good facial seal. These conditions may include but are not limited to facial hair, such as the growth of beard, sideburns, or excessive mustaches, and possibly the wearing of corrective eyeglasses.
- If spectacles, goggles, face shields, or welding helmets must be worn with a facepiece, they will be worn so as not to adversely affect the seal of the facepiece to the face.
- For all tight-fitting respirators, a positive and negative pressure seal check shall be performed each time the respirator is donned. Seal checks shall be performed as follow:
  - *Negative pressure check:* Close off the inlet opening of the canister or cartridge(s) by covering it with the palm of the hand(s), inhale gently so that the facepiece collapses slightly, and hold the breath for 10 seconds. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is satisfactory.
  - *Positive pressure check*: Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. The exhalation valve cover may have to be removed to perform this procedure.

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- *Manufacturer's recommended seal check*: If the respirator manufacturer recommends specific procedures for performing a user seal check, these procedures may be used instead of the negative and positive pressure checks.

- Work areas must be monitored for conditions that may adversely affect the effectiveness of respiratory protection. Employees may leave the work area where respirators are required under the following conditions:

  - To wash the face and respirator facepieces as necessary to prevent eye or skin irritation

  - If vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece is detected

  - To replace the respirator or the filter, cartridge, or canister elements

  - If established monitoring instrument action levels are exceeded

  - For any other criteria as established in a project specific health and safety plan

3.0 RESPIRATOR USE DURING EMERGENCY SITUATIONS

Emergency situations may arise during the wearing of respiratory protection. These situations could include medical emergency, respirator failure, fire, chemical spills or leaks, and other events that pose an immediate risk. Procedures for respirator use during emergency situations are summarized below.

- When an emergency situation arises that creates or has the potential to create immediately dangerous to life and health (IDLH) conditions, the work environment shall be evacuated immediately and shall not be reentered by employees without suitable protective gear.

- Work environments with the potential for the development of atmospheres that may present IDLH conditions shall only be entered by employees using the buddy system.

- When an emergency situation arises that includes physical hazards that may interfere with the proper use of respiratory protection, the work environment shall be evacuated.

- Under no circumstances shall respirator users remove facepieces in hazardous atmospheres. In the event of respirator malfunction, users should leave the hazardous environment immediately and proceed to a known safe location before removal of the facepiece.

- Episodes of respirator failure shall be thoroughly investigated before work activities begin again. The investigation shall include re-evaluation of work area atmospheric

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conditions, review of the respirator selection criteria and service life calculations, and an evaluation of the working conditions under which respirator failure occurred.

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APPENDIX C

RESPIRATORY HAZARD ASSESSMENT (FORM RP-2)

Note: This assessment form will be finalized when site air monitoring data are collected and evaluated. Until the assessment is completed, air purifying respirator cartridges will be disposed of every 8 hours.

TETRA TECH, INC.

RESPIRATORY HAZARD ASSESSMENT

Project Name:		Project No.:
Location:		Project Manager:
Type: ☐ Baseline ☐ Reassessment	Date:	Valid for _____ days
Job/Task Description:		☐ Routine ☐ Escape
Hazard Identification and Source:	Workplace Factors: Temperature: _____ Humidity: _____ Other: _____	User Factors: Work rate: _____ Protective clothing: _____ Other: _____

Chemical:					
PEL:					
ACGIH TLV:					
Form (part/gas/vapor):					
IDLH:					
Eye Irritant (Y/N):					
Skin Absorption(Y/N):					
Monitoring (Y/N) :*					
Frequency:					
Maximum Concentration Estimated:**					

* Monitoring Method: ☐ PID ☐ NIOSH method: _____ ☐ FID ☐ Vapor badge: _____ ☐ Detector tube: _____ ☐ Other: _____	Respirator Type: ☐ Half-face disposable Brand: _____ ☐ Half-face reusable Brand: _____ ☐ Full-face Brand: _____ ☐ Air-supplied airline Brand: _____ ☐ Air-supplied SCBA Brand: _____ ☐ PAPR Brand: _____ ☐ ESCBA Brand: _____
** If concentrations exceed the immediately dangerous to life and health (IDLH) value, use air-supplied systems.	Vapor and Gas Cartridge Exchange: ESLI: ☐ Yes ☐ No Exchange frequency: _____
Cartridge/Filter Selection ☐ N100 ☐ R100 ☐ P100 ☐ N99 ☐ R99 ☐ P99 ☐ N95 ☐ R95 ☐ P95 ☐ Organic vapor ☐ Acid gas ☐ Ammonia ☐ Mercury ☐ Formaldehyde ☐ Combo: _____ ☐ Other: _____	Basis for Exchange Frequency ☐ Manufacturer's data ☐ Workplace simulations ☐ Experimental methods ☐ AIHA "Rules of Thumb" ☐ Predictive modeling ☐ Analogous chemical structure ☐ OSHA Regulation: _____ ☐ Other: _____
_____ _____ Completed by Date	_____ _____ Reviewed by Date

DEFINITIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ESLI	End of service life indicator
FID	Flame ionization detector
IDLH	Immediately dangerous to life and health
NIOSH	National Institute for Occupational Safety and Health
N100/99/95	Non-oil-proof particulate filter
OSHA	Occupational Safety and Health Administration
P100/99/95	Oil-proof particulate filter
PEL	Permissible exposure limit
PID	Photoionization detector
PPE	Personal protective equipment
R100/99/95	Oil-resistant particulate filter
SCBA	Self-contained breathing apparatus
TLV	Threshold limit value

Note: This form must be reviewed by a regional health and safety representative or subsidiary health and safety representative (or designee) only and must be attached to the site-specific health and safety plan once completed. A copy must also be placed in the project files.

ATTACHMENT

MATERIAL SAFETY DATA SHEETS

- Liquinox
- Hydrochloric acid
- Nitric acid

HACH CO -- 20881 LIQUI-NOX DETERGENT -- 7930-01-267-5600

========== Product Identification ==========

Product ID:20881 LIQUI-NOX DETERGENT
MSDS Date:08/05/1986
FSC:7930
NIIN:01-267-5600
MSDS Number: BGSBD
=== Responsible Party ===
Company Name:HACH CO
Address:100 DAYTON RD
Box:907
City:AMES
State:IA
ZIP:50010-0642
Country:US
Info Phone Num:303-669-3050 OR 800-227-4224
Emergency Phone Num:515-232-2533 800-247-3990
CAGE:4T252
=== Contractor Identification ===
Company Name:HACH CO
Address:5600 LINDBERGH DR
Box:389
City:LOVELAND
State:CO
ZIP:80539
Country:US
Phone:970-669-3050/ 303-623-5716
CAGE:91224
Company Name:HACH COMPANY
Address:100 DAYTON RD.
Box:907
City:AMES
State:IA
ZIP:50010
Country:US
Phone:800-227-4224
CAGE:4T252

========== Composition/Information on Ingredients ==========

Ingred Name:2-BUTOXYETHANOL
CAS:111-76-2
RTECS #:KJ8575000
Fraction by Wt: <5%
Other REC Limits:ACGIH STEL 75 PPM
OSHA PEL:S, 50 PPM
ACGIH TLV:S, 25 PPM; 9293

Ingred Name:PROPRIETARY COMPONENTS
Fraction by Wt: TO 100%

========== Hazards Identification ==========

Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO
Health Hazards Acute and Chronic:PRODUCT IS IRRITATING TO

EYES,SKIN,RESPIRATORY TRACT.
Effects of Overexposure:SEVERE TO MILD IRRITATION OF EYES,MUCOUS MEMBRANES.
Medical Cond Aggravated by Exposure:NONE REPORTED.

First Aid Measures

First Aid:EYE:FLUSH WITH WATER 15 MIN. SKIN:FLUSH WITH WATER. INHALED:REMOVE TO FRESH AIR. INGESTED:GIVE LARGE QUANTITIES OF MILK OR WATER. INDUCE VOMITING. GET MEDICAL ATTENTION. (NOTHING BY MOUTH IF UNCONSCIO US.

Fire Fighting Measures

Flash Point:NONE
Extinguishing Media:WATER,DRY CHEMICAL,FOAM,CARBON DIOXIDE.
Fire Fighting Procedures:WEAR SELF CONTAINED BREATHING APPARATUS.
Unusual Fire/Explosion Hazard:MAY EMIT TOXIC FUMES

Accidental Release Measures

Spill Release Procedures:ABSORB INERT MATERIAL OR DILUTE WITH WATER.
Neutralizing Agent:NONE

Handling and Storage

Handling and Storage Precautions:STORE TIGHTLY CLOSED IN A COOL,DRY AREA.

Exposure Controls/Personal Protection

Respiratory Protection:NONE NORMALLY NEEDED. USE NIOSH RESPIRATOR OR SUPPLIED AIR RESPIRATOR IF EXPOSED ABOVE TLV.
Ventilation:USE HOOD OR OTHER LOCAL EXHAUST TO MAINTAIN EXPOSURE BELOW TLV.
Protective Gloves:NONE.
Eye Protection:SAFETY GLASSES.
Other Protective Equipment:EYE WASH,SAFETY SHOWER, LAB COAT OR APRON.
Work Hygienic Practices:USE NORMAL CHEMICAL HYGIENE PRACTICES.
Supplemental Safety and Health

Physical/Chemical Properties

HCC:N1
Boiling Pt:B.P. Text:210F/99C
Spec Gravity:1.065
pH:8.3+.3
Solubility in Water:MISCIBLE
Appearance and Odor:YELLOW LIQUID,SLIGHT ODOR.

Stability and Reactivity Data

Stability Indicator/Materials to Avoid:YES
STRONG OXIDIZING AGENTS.
Stability Condition to Avoid:NONE REPORTED.
Hazardous Decomposition Products:SULFUR OXIDES AND NORMAL PRODUCTS OF COMBUSTION.

========== Disposal Considerations ==========

Waste Disposal Methods:DISPOSE I/A/W FEDERAL,STATE,LOCAL REGULATIONS.
MFR SUGGESTS FLUSH TO DRAIN.

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Material Safety Data Sheet

Hydrochloric Acid, 25%

ACC# 91596

Section 1 - Chemical Product and Company Identification

MSDS Name: Hydrochloric Acid, 25%
Catalog Numbers: SA8121, SA81220, SA8124
Synonyms: Muriatic acid; Chlorohydric acid; Hydrogen chloride; Spirits of salt
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7732-18-5	Water	75%	231-791-2
7647-01-0	Hydrochloric Acid	25%	231-595-7

Hazard Symbols: T C
Risk Phrases: 23 35

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: colorless to slight yellow clear liquid. **Danger!** Corrosive. Causes eye and skin burns. May cause severe respiratory tract irritation with possible burns. May cause severe digestive tract irritation with possible burns. May cause fetal effects based upon animal studies. Possible sensitizer. May be harmful if swallowed.
Target Organs: Respiratory system, teeth, circulatory system.

Potential Health Effects
Eye: May cause irreversible eye injury. Vapor or mist may cause irritation and severe burns. Contact with liquid is corrosive to the eyes and causes severe burns. May cause painful sensitization to light.
Skin: May be absorbed through the skin in harmful amounts. May cause skin

sensitization, an allergic reaction, which becomes evident upon re-exposure to this material. Contact with liquid is corrosive and causes severe burns and ulceration.
Ingestion: May cause circulatory system failure. Causes severe digestive tract burns with abdominal pain, vomiting, and possible death. May cause corrosion and permanent tissue destruction of the esophagus and digestive tract. May be harmful if swallowed.
Inhalation: May cause severe irritation of the respiratory tract with sore throat, coughing, shortness of breath and delayed lung edema. Causes chemical burns to the respiratory tract. Exposure to the mist and vapor may erode exposed teeth. Causes corrosive action on the mucous membranes.
Chronic: Prolonged or repeated skin contact may cause dermatitis. Repeated exposure may cause erosion of teeth. May cause fetal effects. Laboratory experiments have resulted in mutagenic effects. Prolonged exposure may cause conjunctivitis, photosensitization, and possible blindness.

Section 4 - First Aid Measures

Eyes: Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed. Extensive irrigation with water is required (at least 30 minutes). SPEEDY ACTION IS CRITICAL!
Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Destroy contaminated shoes.
Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately. Give milk of magnesia.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air immediately. If breathing is difficult, give oxygen. Do NOT use mouth-to-mouth resuscitation. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask.
Notes to Physician: Do NOT use sodium bicarbonate in an attempt to neutralize the acid.
Antidote: Do NOT use oils or ointments in eye.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Not flammable, but reacts with most metals to form flammable hydrogen gas. Use water spray to keep fire-exposed containers cool. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas. Reaction with water may generate much heat which will increase the concentration of fumes in the air. Containers may explode when heated.
Extinguishing Media: For large fires, use water spray, fog, or alcohol-resistant foam. Substance is nonflammable; use agent most appropriate to extinguish

surrounding fire. Do NOT get water inside containers. Do NOT use straight streams of water. Most foams will react with the material and release corrosive/toxic gases. Cool containers with flooding quantities of water until well after fire is out. For small fires, use carbon dioxide (except for cyanides), dry chemical, dry sand, and alcohol-resistant foam.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 3; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Large spills may be neutralized with dilute alkaline solutions of soda ash (sodium carbonate, Na_2CO_3), or lime (calcium oxide, CaO). Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Remove all sources of ignition. Provide ventilation. Do not get water inside containers. A vapor suppressing foam may be used to reduce vapors. Cover with dry earth, dry sand, or other non-combustible material followed with plastic sheet to minimize spreading and contact with water.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Contents may develop pressure upon prolonged storage. Do not breathe dust, vapor, mist, or gas. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Do not ingest or inhale. Discard contaminated shoes. Use caution when opening. Keep from contact with moist air and steam.
Storage: Do not store in direct sunlight. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Corrosives area. Do not store in metal containers. Do not store near flammable or oxidizing substances (especially nitric acid or chlorates).

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Water	none listed	none listed	none listed
Hydrochloric Acid	2 ppm Ceiling	50 ppm IDLH	5 ppm Ceiling; 7 mg/m3 Ceiling

OSHA Vacated PELs: Water: No OSHA Vacated PELs are listed for this chemical. Hydrochloric Acid: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear neoprene or polyvinyl chloride gloves to prevent exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

Section 9 - Physical and Chemical Properties

Physical State: Clear liquid
Appearance: colorless to slight yellow
Odor: strong, pungent
pH: 0.01
Vapor Pressure: 5.7 mm Hg @ 0 deg C
Vapor Density: 1.26
Evaporation Rate:> 1.00 (N-butyl acetate)
Viscosity: Not available.
Boiling Point: 81.5-110 deg C @ 760 mmHg
Freezing/Melting Point:-74 deg C
Decomposition Temperature: Not available.
Solubility: Miscible.
Specific Gravity/Density:1.0-1.2
Molecular Formula:HCl.H2O
Molecular Weight:36.46

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Mechanical shock, incompatible materials, metals, excess heat, exposure to moist air or water, bases.
Incompatibilities with Other Materials: Bases, acetic anhydride, alkali metals, aluminum, amines, copper, copper alloys, fluorine, iron, sodium hydroxide, steel, sulfuric acid, vinyl acetate, zinc, potassium permanganate, cesium acetylene carbide, rubidium acetylene carbide, rubidium carbide, sodium, chlorosulfonic acid, oleum, carbonates, perchloric acid, calcium phosphide, metal oxides, acetates, cesium carbide, beta-propiolactone, ethyleneimine, propylene oxide, lithium silicides,

alcohols + hydrogen cyanide, 2-aminoethanol, ammonium hydroxide, calcium carbide, 1,1-difluoroethylene, ethylene diamine, magnesium boride, mercuric sulfate, silver perchlorate + carbon tetrachloride, uranium phosphide.
Hazardous Decomposition Products: Hydrogen chloride, chlorine, carbon monoxide, carbon dioxide, hydrogen gas.
Hazardous Polymerization: Will not occur.

Section 11 - Toxicological Information

RTECS#:
CAS# 7732-18-5: ZC0110000
CAS# 7647-01-0: MW4025000; MW4031000
LD50/LC50:
CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;<BR.

CAS# 7647-01-0:
Inhalation, mouse: LC50 = 1108 ppm/1H;
Inhalation, mouse: LC50 = 8300 mg/m3/30M;
Inhalation, rat: LC50 = 3124 ppm/1H;
Inhalation, rat: LC50 = 45000 mg/m3/5M;
Inhalation, rat: LC50 = 8300 mg/m3/30M;
Oral, rabbit: LD50 = 900 mg/kg;<BR.

Carcinogenicity:
CAS# 7732-18-5: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 7647-01-0:
ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: IARC Group 3 - not classifiable
Epidemiology: Experimental reproductive effects have been reported.
Teratogenicity: Embryo or Fetus: Stunted fetus, Inhalation, rat TCL0=450 mg/m3/1H Specific Developmental Abnormalities: homeostatis, Inhalation, rat TCL0=450 mg/m3/1H (female 1 days pre-mating).
Reproductive Effects: No information available.
Neurotoxicity: No information available.
Mutagenicity: Cytogenetic analysis: Hamster, lung = 30 mmol/L.; Cytogenetic analysis: Hamster, ovary = 8 mmol/L.
Other Studies: No data available.

Section 12 - Ecological Information

Ecotoxicity: Fish: Bluegill/Sunfish: 3.6 mg/L; 48Hr; Lethal (unspecified) Bluegill/Sunfish: LC50; 96 Hr; pH 3.0-3.5 No data available.
Environmental: Rapidly hydrolyzes when exposed to water. Will exhibit extensive evaporation from soil surfaces. Upon transport through the soil, hydrochloric acid will dissolve some of the soil materials (especially those with carbonate bases) and the acid will neutralize to some degree.

Physical: No information available.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	HYDROCHLORIC ACID				HYDROCHLORIC ACID SOLUTION
Hazard Class:	8				8
UN Number:	UN1789				UN1789
Packing Group:	II				II

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 7732-18-5 is listed on the TSCA inventory.
CAS# 7647-01-0 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA

CERCLA Hazardous Substances and corresponding RQs
CAS# 7647-01-0: 5000 lb final RQ; 2270 kg final RQ
SARA Section 302 Extremely Hazardous Substances
CAS# 7647-01-0: 500 lb TPQ
SARA Codes
CAS # 7647-01-0: acute.
Section 313
This material contains Hydrochloric Acid (CAS# 7647-01-0, 25%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
CAS# 7647-01-0 is listed as a hazardous air pollutant (HAP). This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 7647-01-0 is listed as a Hazardous Substance under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 7647-01-0 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
T C
Risk Phrases:
R 23 Toxic by inhalation.
R 35 Causes severe burns.

Safety Phrases:
S 1/2 Keep locked up and out of reach of children.
S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 36/37/39 Wear suitable protective clothing, gloves and eye/face protection.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 9 Keep container in a well-ventilated place.

WGK (Water Danger/Protection)
CAS# 7732-18-5: No information available.
CAS# 7647-01-0: 1
Canada - DSL/NDSL
CAS# 7732-18-5 is listed on Canada's DSL List.
CAS# 7647-01-0 is listed on Canada's DSL List.
Canada - WHMIS

This product has a WHMIS classification of E, D2A.

Canadian Ingredient Disclosure List

CAS# 7647-01-0 is listed on the Canadian Ingredient Disclosure List.

Exposure Limits

CAS# 7647-01-0: OEL-AUSTRALIA:TWA 5 ppm (7 mg/m3) OEL-AUSTRIA:TWA 5 ppm (7 mg/m3) OEL-BELGIUM:STEL 5 ppm (7.7 mg/m3) OEL-DENMARK:STEL 5 ppm (7 mg/m3) OEL-FINLAND:STEL 5 ppm (7 mg/m3);Skin OEL-FRANCE:STEL 5 ppm (7.5 mg/m3) OEL-GERMANY:TWA 5 ppm (7 mg/m3) OEL-HUNGARY:STEL 5 mg/m3 OEL-JAPAN:STEL 5 ppm (7.5 mg/m3) OEL-THE NETHERLANDS:TWA 5 ppm (7 mg/m3) OEL-THE PHILIPPINES:TWA 5 ppm (7 mg/m3) OEL-POLAND:TWA 5 mg/m3 OEL-RUSSIA:STEL 5 ppm (5 mg/m3) OEL-SWEDEN:STEL 5 ppm (8 mg/m3) OEL-SWITZERLAND:TWA 5 ppm (7.5 mg/m3);STEL 10 ppm (15 mg/m3) OEL-THAILAND:TWA 5 ppm (7 mg/m3) OEL-TURKEY:TWA 5 ppm (7 mg/m3) OEL-UNITED KINGDOM:TWA 5 ppm (7 mg/m3);STEL 5 ppm (7 mg/m3) OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

Section 16 - Additional Information

MSDS Creation Date: 7/07/2000
Revision #4 Date: 3/18/2003

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Material Safety Data Sheet

Nitric Acid

ACC# 16550

Section 1 - Chemical Product and Company Identification

MSDS Name: Nitric Acid
Catalog Numbers: S71972, S71972MF, S75623-2, S75623-3, S76523, A198C-212, A198C4X-212, A200-212, A200-500, A200-612GAL, A200C-212, A200C4X-212, A200C4X2001, A200C4X2122, A200C4X212L, A200J500, A200S-212, A200S-500, A200S4X-212, A200S4X212L, A200SI-212, A467-1, A467-2, A467-250, A467-500, A483-212, A509-212, A509-500, A509SK-212, S719721, S719721MF, S71972SC
Synonyms: Azotic Acid; Engravers Nitrate; Hydrogen Nitrate.
Company Identification:

Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410

For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7697-37-2	Nitric acid	69-71	231-714-2
7732-18-5	Water	29-31	231-791-2

Hazard Symbols: O C
Risk Phrases: 35 8

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: clear to yellow liquid. **Danger!** Corrosive. Strong oxidizer. Contact with other material may cause a fire. Causes eye and skin burns. Check internal container upon receipt. Bottles should be vented periodically to relieve pressure. Causes digestive and respiratory tract burns.
Target Organs: Eyes, skin, mucous membranes.

Potential Health Effects

Eye: Causes severe eye burns. May cause irreversible eye injury. May cause chemical conjunctivitis and corneal damage.
Skin: Causes skin burns. May cause deep, penetrating ulcers of the skin. May cause skin rash (in milder cases), and cold and clammy skin with cyanosis or pale color.
Ingestion: May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the digestive tract. May cause systemic effects.
Inhalation: Effects may be delayed. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Aspiration may lead to pulmonary edema. May cause systemic effects. May cause acute pulmonary edema, asphyxia, chemical pneumonitis, and upper airway obstruction caused by edema.
Chronic: Repeated inhalation may cause chronic bronchitis. Repeated exposure may cause erosion of teeth. Effects may be delayed.

Section 4 - First Aid Measures

Eyes: Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed. Extensive irrigation with water is required (at least 30 minutes).
Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Destroy contaminated shoes.
Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Do NOT use mouth-to-mouth resuscitation. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Strong oxidizer. Contact with combustible materials may cause a fire. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Use water with caution and in flooding amounts.
Extinguishing Media: Substance is noncombustible; use agent most appropriate to extinguish surrounding fire. Contact professional fire-fighters immediately.

Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 4; Flammability: 0; Instability: 0; Special Hazard: OX

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Neutralize spill with sodium bicarbonate. Provide ventilation. A vapor suppressing foam may be used to reduce vapors.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Do not breathe dust, vapor, mist, or gas. Keep container tightly closed. Avoid contact with clothing and other combustible materials. Do not get on skin or in eyes. Avoid ingestion and inhalation. Discard contaminated shoes.
Storage: Keep away from heat, sparks, and flame. Do not store near combustible materials. Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Bottles should be vented periodically in order to overcome pressure buildup.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Nitric acid	2 ppm TWA; 4 ppm STEL	2 ppm TWA; 5 mg/m3 TWA 25 ppm IDLH	2 ppm TWA; 5 mg/m3 TWA
Water	none listed	none listed	none listed

OSHA Vacated PELs: Nitric acid: 2 ppm TWA; 5 mg/m3 TWA Water: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate gloves to prevent skin exposure.
Clothing: Wear a chemical apron. Wear appropriate clothing to prevent skin exposure.
Respirators: Wear a NIOSH/MSHA or European Standard EN 149 approved full-facepiece airline respirator in the positive pressure mode with emergency escape provisions.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: clear to yellow
Odor: strong odor - acrid odor
pH: 1.0
Vapor Pressure: 6.8 mm Hg
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 186.8 deg F
Freezing/Melting Point:-43.6 deg F
Decomposition Temperature: Not available.
Solubility: Soluble in water.
Specific Gravity/Density:1.50
Molecular Formula:HNO3
Molecular Weight:63.0119

Section 10 - Stability and Reactivity

Chemical Stability: Stable. Decomposes when in contact with air, light, or organic matter.
Conditions to Avoid: High temperatures, incompatible materials, ignition sources, moisture, combustible materials, reducing agents.
Incompatibilities with Other Materials: Reducing agents, combustible materials, strong bases, alcohols, aldehydes, cyanides, metals, Incompatible with many substances..
Hazardous Decomposition Products: Nitrogen oxides.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 7697-37-2: QU5775000; QU5900000
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 7697-37-2:
Inhalation, rat: LC50 = 260 mg/m3/30M;
Inhalation, rat: LC50 = 130 mg/m3/4H;
Inhalation, rat: LC50 = 67 ppm(NO2)/4H;<BR.

CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;<BR.

Carcinogenicity:
CAS# 7697-37-2: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 7732-18-5: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology: No information found.
Teratogenicity: No information found.
Reproductive Effects: No information found.
Neurotoxicity: No information found.
Mutagenicity: No information found.
Other Studies: See actual entry in RTECS for complete information.

Section 12 - Ecological Information

Ecotoxicity: No data available. No information available.
Environmental: Terrestial: During transport through the soil, nitric acid will dissolve some of the soil material, in particular, the carbonate based materials. The acid will be neutralized to some degree with adsorption of the proton also occurring on clay materials. However, significant amounts of acid are expected to remain for transport down toward the ground water table. Upon reaching the ground water table, the acid will continue to move, now in the direction of the ground water flow.
Physical: Not expected to biodegrade or bioconcentrate.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate

classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	NITRIC ACID				NITRIC ACID
Hazard Class:	8				8(9.2)
UN Number:	UN2031				UN2031
Packing Group:	II				II

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 7697-37-2 is listed on the TSCA inventory.
CAS# 7732-18-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA

CERCLA Hazardous Substances and corresponding RQs
CAS# 7697-37-2: 1000 lb final RQ; 454 kg final RQ
SARA Section 302 Extremely Hazardous Substances
CAS# 7697-37-2: 1,000 lb TPQ
SARA Codes
CAS # 7697-37-2: acute, chronic, flammable.
Section 313
This material contains Nitric acid (CAS# 7697-37-2, 69 71%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2

Ozone depletors.
Clean Water Act:
CAS# 7697-37-2 is listed as a Hazardous Substance under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 7697-37-2 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
O C
Risk Phrases:
R 35 Causes severe burns.
R 8 Contact with combustible material may cause fire.

Safety Phrases:
S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 36 Wear suitable protective clothing.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S23B Do not breathe fumes.

WGK (Water Danger/Protection)
CAS# 7697-37-2: 1
CAS# 7732-18-5: No information available.
Canada - DSL/NDSL
CAS# 7697-37-2 is listed on Canada's DSL List.
CAS# 7732-18-5 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of C, D1A, E.
Canadian Ingredient Disclosure List
CAS# 7697-37-2 is listed on the Canadian Ingredient Disclosure List.
Exposure Limits
CAS# 7697-37-2: OEL-ARAB Republic of Egypt:TWA 2 ppm (5 mg/m3) OEL-AUSTRALIA:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) OEL-BELGIUM:TWA 2 ppm (5.2 mg/m3);STEL 4 ppm (10 mg/m3) OEL-CZECHOSLOVAKIA:TWA 2.5 mg/m3;STEL 5 mg/m3 OEL-DENMARK:TWA 2 ppm (5 mg/m3) OEL-FINLAND:TWA 2 ppm (5 mg/m3);STEL 5 ppm (13 mg/m3);Skin OEL-FRANCE:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) OEL-GERMANY:TWA 10 ppm (25 mg/m3) OEL-HUNGARY:STEL 5 mg/m3 OEL-JAPAN:TWA 2 ppm (5.2 mg/m3) OEL-THE PHILIPPINES:TWA 2 ppm (5 mg/m3) OEL-POLAND:TWA 10 mg/m3 OEL-RUSSIA:TWA 2 ppm;STEL 2 mg/m3;Skin OEL-SWEDEN:TWA 2 ppm (5 mg/m3);STEL 5 ppm (13 mg/m3) OEL-SWITZERLAND:TWA 2 ppm (5 mg/m3);STEL 4 ppm (1 mg/m3) OEL-THAILAND:T

WA 2 ppm (5 mg/m3) OEL-TURKEY:TWA 2 ppm (5 mg/m3) OEL-UNITED KINGDOM :TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

Section 16 - Additional Information

MSDS Creation Date: 9/30/1998
Revision #10 Date: 4/01/2003

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.