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HEALTH AND SAFETY DESIGN ANALYSIS UNDERGROUND STORAGE TANK REMOVAL ATLANTIC STREET GAS STATION FORT STORY VA

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HEALTH AND SAFETY DESIGN ANALYSIS

UNDERGROUND STORAGE TANK REMOVAL
ATLANTIC STREET GAS STATION

FORT STORY, VIRGINIA

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FORT STORY, VIRGINIA BEACH, VIRGINIA

ATLANTIC STREET GAS STATION
UNDERGROUND STORAGE TANK REMOVAL PROJECT

HEALTH AND SAFETY DESIGN ANALYSIS

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HEALTH AND SAFETY DESIGN ANALYSIS

1.0 INTRODUCTION

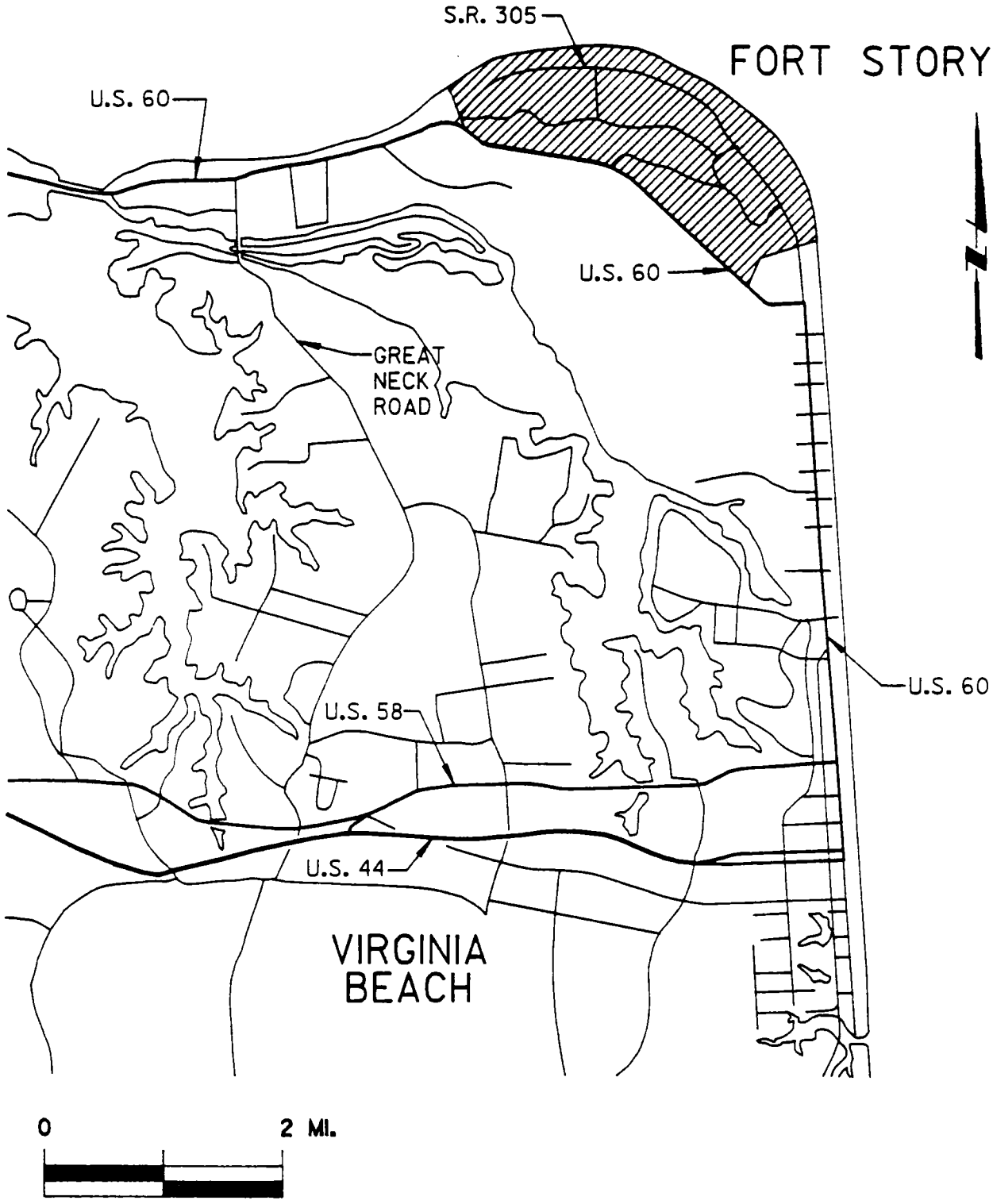
This Health and Safety Design Analysis (HSDA) is submitted by James M. Montgomery, Consulting Engineers, Inc. (JMM) in support of the U.S. Army Corps of Engineers (USACE) Contract No. DACW 45-89-D-0501, Delivery Order 0015. It will serve as a design analysis tool for health and safety related aspects of the construction and remediation activities associated with the underground storage tank (UST) removal project at the Atlantic Street Gas Station, Fort Story, Virginia. This HSDA provides health and safety criteria and practices to address protection of on-site personnel, the public, and the environment from physical and chemical hazardous unique to the Atlantic Street Gas Station UST removal project.

The specific requirements of this HSDA will form the basis for a technical provision in the UST removal contract that requires the Contractor to develop a detailed Site Safety and Health Plan (SSHP), formerly known as a Safety, Health, and Emergency Response Plan (SHERP). The resulting Contractor SSHP shall be reviewed and approved by the USACE Contracting Officer (CO) prior to initiation of site field activities. The Contractor program shall be in accordance with federal Occupational Safety and Health Administration (OSHA) regulations, specifically in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response." The Contractor shall comply with all applicable Federal OSHA, State and local occupational health regulations and requirements. Working conditions may require modification of the approved Contractor SSHP. Except in emergency situations, no deviations from the Contractor SSHP may be implemented without the prior notification and approval of the Contractor industrial hygienist and the CO.

2.0 SITE DESCRIPTION, PROJECT ACTIVITIES, AND CONTAMINANT CHARACTERIZATION

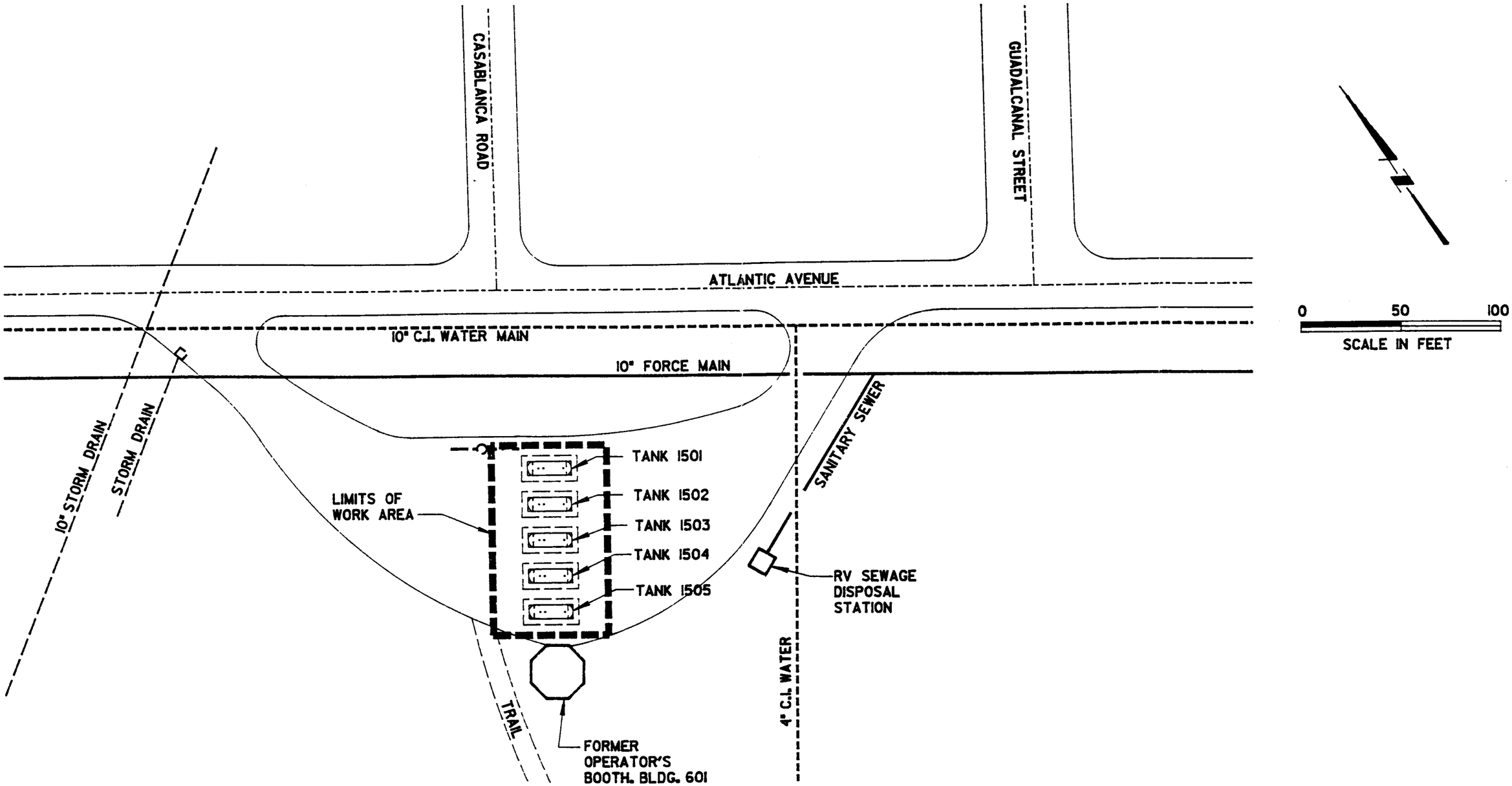
2.1 Site Description

Fort Story is located in southeastern Virginia. Fort Story is a sub-Installation of Fort Eustis and is located on Cape Henry in Virginia Beach, Virginia. Fort Story is located approximately 2 miles north of the Virginia Beach resort area and is bounded by the Atlantic Ocean and the Chesapeake Bay to the north, and Virginia Seashore State Park to the south. An area map of Fort Story is presented in Figure 2-1. The Atlantic Street Gas Station, located in the eastern portion of Fort Story, is situated opposite of the intersection of Atlantic Avenue and Casablanca Road (Figure 2-2). The ATGAS site is the location of a former World War II-era service station which reportedly has been out of operation since at least 1970. There is a sewage pump station located at the site which serves the adjacent Army Travel Camp bathhouse and trailer park area. A former service station operator's booth, presently being used as a campground office, a large paved (tarmac) area, five inactive concrete service islands with abandoned pump pipes, and a recently constructed pump station currently exist at the site.



VICINITY MAP

FIGURE 2-1



SITE PLAN

FIGURE 2-2

Background records and as-built drawings are not available for the site. According to Fort Story personnel, records may have been destroyed by a past building fire. The USTs may have originally stored gasoline and diesel fuels. Also, the USTs may have been used for an indeterminate period of time to store heavier heating fuel oils

A preliminary site investigation (SI) conducted at the ATGAS site involved locating the USTs and sampling the tanks' contents. Only three of the five tanks identified at the site were sampled. Two tanks contained free product. One sample was collected from each of the tanks containing free product. One tank contained an aqueous phase. Four samples were collected from the tank containing the aqueous phase. Table 2-1 presents a summary of contaminant ranges detected during the SI.

TABLE 2-1

ATGAS CONTAMINANTS

Parameter	Number of Detections	Concentration Range	Detection Limit
Tank Contents - Free Product			
Total Organic Halogens	0	ND	100 mg/kg
Polychlorinated Biphenyls	0	ND	5.0 mg/kg
Arsenic	0	ND	5.0 mg/kg
Cadmium	0	ND	2.5 mg/kg
Chromium	0	ND	2.5 mg/kg
Lead	0	ND	2.5 mg/kg
Tank Contents - Aqueous			
Total Fuel Hydrocarbons (light)	4	49 - 62 mg/l	0.050 mg/l
Total Organic Halogens	4	910 - 1200 µg/l	200 - 400 µg/l
Arsenic	0	ND	0.01 mg/l
Cadmium	1	0.005 mg/l	0.005 mg/l
Chromium	0	ND	0.01 mg/l
Lead	2	0.32 - 0.49 mg/l	0.01 mg/l
Polychlorinated Biphenyls	0	ND	0.5 µg/l

The presence of contaminants at the ATGAS site is summarized as follows:

1. Lead was present in the two of the aqueous phase samples collected from Tank 1505. The concentrations of lead detected were 0.32 mg/l and 0.49 mg/l.

2. Cadmium was present one of the aqueous samples collected from Tank 1505, at a concentration of 0.005 mg/l.

3. Total organic halogens (TOX) were present in the tank which contained the aqueous phase. The concentration of TOX in the four samples collected from the tank ranged from 910 µg/l to 1200 µg/l.

2.2 Site Activities

The UST removal activities to be conducted at the site consist of (1) removal and disposal of five 10,000-gallon USTs used to store petroleum hydrocarbons and all associated piping, (2) removal and disposal of all tank contents (water and petroleum products), (3) removal and disposal of petroleum-contaminated soils, and (4) confirmatory soil sampling in the bottom of the UST excavations.

2.3 Chemical Contaminant Characterization.

The inventory of hazardous materials consists of gasoline but may include other petroleum products such as waste oils and fuel oil. These compounds are hazardous via inhalation, ingestion, and upon contact with the skin.

2.3.1 Fuel Oil. #2 Fuel Oil is present in many of the underground storage tanks to be removed. Fuel oils are considered to be miscellaneous combustible or flammable materials for compatibility classification purposes. Diesel fuel is predominantly a mixture of C10 through C19 straight-chain hydrocarbons. As with automotive gasoline, diesel fuels contain a number of additives. The effects of exposure to fuel oils are expected to resemble those of kerosene. Inhalation of high concentrations may cause headache, nausea, confusion, drowsiness, convulsions, and coma. Ingestion may cause nausea, vomiting and, in severe cases, drowsiness progressing to coma. Aspiration may cause extensive pulmonary injury. The liquid may produce primary skin irritation. Long-term exposures can effect the kidneys. OSHA has established an 8-hour TWA Permissible Exposure Limit (PEL) to petroleum distillates (VM & P Naptha) at 400 ppm. The lower explosive limit (LEL) for fuel oils in air range from 0.6% to 1.3%.

2.3.2 Gasoline. Automotive gasoline is composed of several hundred hydrocarbons in the range of C4 to C11; the concentrations of specific hydrocarbons in different gasoline samples has been found to be highly variable. Automotive gasoline also contains a number of additives used as octane improvers, antioxidants, metal deactivators, corrosion or icing inhibitors, detergent or demulsifiers. Overexposure to gasoline has been shown to cause central nervous system (CNS) effects, dermatitis, and blistering of the skin. Effects of overexposure may be evidenced by dizziness; vomiting, nausea; blurred vision; symptoms of intoxication; and irritation of the eyes, nose, and throat. Long-term exposures can affect the kidneys. The American Conference of Governmental Industrial Hygienists (ACGIH) has established for 1990-91 a Threshold Limit Value (TLV) for occupational exposure to gasoline at 890 mg/m3 (300 ppm), based upon an 8-hour Time Weighted Average (TWA). The ACGIH Short Term Exposure Limit (STEL) established for gasoline is 1480 mg/m3 (500 ppm). OSHA has set no exposure standards. The Lower Explosive Level (LEL) for gasoline in air is 1.4% (14,000 ppm). The primary constituents of concern in gasoline/jet fuel are mixed petroleum hydrocarbons, benzene, ethyl benzene, toluene, and xylene. Trace metals may be present, but are expected at low levels in soil samples/sludge samples so they should not present an exposure hazard to workers.

2.3.3 Petroleum Hydrocarbons. Petroleum fuels such as gasoline are capable of forming flammable/explosive atmospheres. They are capable of exerting toxic effects on humans through inhalation and skin contact. Inhaling elevated concentrations greater than 300 ppm of gasoline vapors can cause respiratory irritation, narcosis, coma, and in severe instances, death. Prolonged or repeated skin contact is capable of causing loss of skin oils leading to irritation or severe dermatitis.

2.3.4 Benzene. Benzene is a colorless liquid with a characteristic odor. Inhalation of vapor is the primary route of entry. Exposure to liquid and vapor produces irritation to skin, eyes, and upper respiratory tract. Acute exposure to benzene results in headache, dizziness, nausea, convulsions, coma, and possible death. Chronic exposures have been documented to cause blood changes. There is a causal association between benzene exposure and human cancer.

2.3.5 Ethylbenzene. Ethylbenzene is a clear, colorless, flammable liquid found in gasoline. Ethylbenzene is produced commercially by the alkylation of benzene with ethylene. Dermal contact and inhalation of vapors are major pathways for exposure to ethylbenzene. Acute exposure to the vapor results in sleepiness, fatigue, headache and mild eye and respiratory irritation. Systemic toxic effects occur predominantly in the liver and kidney and central nervous system.

2.3.6 Toluene. Toluene occurs naturally as a component of petroleum oil. Releases of toluene to the environment are mainly to air due to toluene's volatile nature, with smaller amounts to water and soil. Exposure of humans to toluene vapor results in fatigue, headache, nausea, muscular weakness, confusion, and incoordination. Chronic abuse of, and occupational exposures to toluene have been associated with hepatomegaly and hepatic function changes.

2.3.7 Xylene. Xylene occurs naturally as a component of petroleum oil. Releases of xylenes to the environment are largely to air due to their volatile nature, with smaller amounts to water and soil. Xylenes are absorbed readily after inhalation. Xylenes produce central nervous system disturbances as reflected in changes in numerative ability, short-term memory and electroencephalographic patterns. They also affect the liver but at much higher concentration.

2.3.8 Waste Oil. Benzene is a constituent of concern present in waste oil which would be a "worst case" potential chemical hazard. The characteristics of benzene are described above.

2.3.9 Total Organic Halogens. TOX were detected in the aqueous sample collected from Tank 1505. Specific compounds were not analyzed for but could potentially include tetrachloroethylene (PCE), trichloroethylene (TCE) and 1,1,1-trichloroethane (TCA). Petroleum hydrocarbons do not naturally contain TOX, however, TOX may be present due to non-fuel related materials being introduced into the tanks. Symptoms of exposure to 1,1,1-trichloroethane and perchloroethylene can include eyes, nose, and throat irritation, nausea, headache, cardiac erythmia, and dizziness. Some TOX compounds (i.e. perchloroethylene) are carcinogens.

3.0 HAZARD ASSESSMENT

Based upon the information presented in Section 2.1 (Site Description), several contaminants may present an occupational hazard during UST removal activities at the ATGAS site. The potential toxic exposure hazard to site personnel associated with ATGAS contaminants (TFH, lead, arsenic, cadmium, chromium and associated constituents such as BETX, halogens) can be expressed in Threshold Limit Values-Time Weighted Averages (TLV-TWA) as established by the American Conference of Governmental Industrial Hygienists (ACGIH), Permissible Exposure Limits (PEL) as mandated by the Occupational Safety and Health Administration (OSHA), Recommended Exposure Limits (REL) as suggested by the National Institute of Occupational Safety and Health (NIOSH), and by Immediately Dangerous to Life or Health (IDLH) values established by NIOSH and OSHA.

The definitions of these health exposure guidelines are as follows:

- **TLV-TWA** is defined as the airborne concentration of a substance to which nearly all workers (8 hours/day, 40 hours/week) may be repeatedly exposed, day after day, without experiencing adverse health effects.

  For some substances, the overall exposure to a substance is intensified by being absorbed by the skin, mucous membranes or eyes, either by airborne, or particularly, by direct contact with the substance. Other substances have a ceiling value, this concentration should not be exceeded during any part of the working day.

- **PELs** are established by federal or state OSHA. PELs may be expressed as an 8-hour Time Weighted Average (TWA) or as a ceiling limit. Ceiling limits may not be exceeded at any time during a work day. PELs are enforceable by law.

- **RELs** are developed by NIOSH. RELs are published guidelines that recommend employee exposure limits for airborne contaminants. RELs are expressed as a TWA or ceiling limit.

- **IDLH** values are defined as conditions that pose an immediate threat to life or health or conditions that pose an immediate threat or severe exposure to contaminants which are likely to have an adverse cumulative or delayed effect on health. Two factors are considered when establishing IDLH concentrations:

  1. The worker must be able to escape within 30 minutes without losing his or her life or suffering permanent health damage. Thirty (30) minutes is considered by OSHA as the maximum permissible exposure time for escape.

  2. The worker must be able to escape without severe eye or respiratory irritation or other reactions that could inhibit escape. If the concentration is above the IDLH levels, only highly reliable breathing apparatus, such as pressure-demand self-contained breathing apparatus (SCBA), is allowed. Since IDLH limits are conservative, any approved respirator may be used up to this limit as long as its maximum use concentration, or the limitations on the air-purifying element are not exceeded.

Table 2-2 identifies occupational health guidelines (TLV-TWA, PEL, REL and IDLH values for the compounds identified) and toxicological information (Routes of exposure, symptoms of acute/chronic exposure, mutagenicity, teratogenicity and carcinogenicity) for the ATGAS contaminants. As shown on Table 2-2, PELs may vary in comparison to the TLV-TWA levels (ACGIH) and RELs (NIOSH). In accordance with EM 385-1-1, all site activities shall comply with the exposure standards mandated by OSHA, or the ACGIH-TLV-TWA, whichever is more stringent. Personnel must be aware of the potential chemical hazards present at the site. For this reason, personnel training will be mandatory prior to working on-site (see Section 6.0), and a daily site safety meeting must be conducted and documented at the beginning of each work shift (see Section 6.0). All remedial activity sites will be clearly delineated with physical barriers; the site exit/entry points will be established upwind of site operations. Atmospheric monitoring for organic vapors will be conducted during remedial activities.

4.0 ACCIDENT PREVENTION

4.1 Accident Prevention Administration. An accident prevention plan is included in this section of the HSDA to comply with the requirements outlined in EM 385-1-1, "Safety and Health Requirements Manual." The health and safety specialist (see Section 5.3) will be responsible for implementation of this accident prevention plan and all on-site personnel will be accountable for reading, understanding, and following the guidelines contained herein.

- An initial indoctrination of all site investigation personnel, and site-specific safety training, will be accomplished during the training session, described in Section 6.0.

- The health and safety specialist will be responsible for maintaining a clean job site free from hazards and providing safe access and egress from the site. Physical barriers delineating a work site will be utilized for traffic control, and limiting access to hazardous and restricted areas.

- Emergency telephone numbers will be posted for the Fire Department, ambulance service, and the nearest emergency medical clinic/hospital. A diagram indicating the fastest route to the clinic/hospital shall also be posted. A mobile telephone will be present on-site during all site activities. The health and safety specialist shall be the lead person in all emergency situations.

- A daily tailgate safety meeting will be conducted to discuss pertinent site safety topics at the beginning of each shift, whenever new personnel arrive at the job site, and as site conditions changes. These meetings shall be conducted by the health and safety specialist.

Should an accident occur, the health and safety specialist shall immediately notify the CO, complete an accident report form, and investigate the cause. Any recommended hazard control measures must be discussed with the industrial hygienist (see Section 5.2) and meet his approval prior to implementation. Any chemical exposures or occupational injuries and illnesses will be reported and recorded. In the event of a lost work day, the accident will be investigated and reported to the CO. If a fatality occurs, five or more persons are admitted to a hospital, or property damage in excess of $10,000 (Class C Accident) occurs, the acci-

TABLE 2-2

OCCUPATIONAL HEALTH GUIDELINES AND TOXICOLOGICAL INFORMATION

Contaminant	ACGIH TLV/TWA	NIOSH REL	OSHA PEL	NIOSH/OSHA IDLH	Routes of Exposure	Symptomology (Acute/Chronic)	Carcinogenicity Mutagenicity Teratogenicity
Fuel Oils/ Petroleum Distillates (VM & P Naphtha)	300 ppm	350	400 ppm	10,000 ppm	Inhalation, skin and/or eye contact, ingestion	Dizziness, drowsiness, headache, nausea; eye, nose and throat irritation, and dry, cracked skin	
Arsenic	0.2 mg/m^3	0.002 mg/m^3	0.01 mg/m^3	100 mg/m^3	Inhalation, ingestion, skin absorption, skin and/or eye contact	Ulceration of nasal septum, dermatitus, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpig-mentation of skin	Human carcinogen
Benzene	10 ppm (NIC 0.1 ppm)	Ca0.1 ppm	1 ppm	Ca 3000 ppm[a]	Inhalation, skin/eye absorption, ingestion, skin/eye contact	Irritation to eyes, nose and respiratory system. Giddiness, headache, nausea, staggered gait, fatigue, anorexia, lassitude, dermatitis bone marrow depression	Human carcinogen
Lead	0.15 mg/m^3	<0.1 mg/m^3	0.05 mg/m^3	NA[b]	Inhalation, ingestion, skin and/or eye contact	Lassitude, insomnia, pallor, anorexia, low weight, constipation, abdominal pain, colic, hypotense, anemia, gingival lead line; paralysis of wrist	Suspect human carcinogen
Cadmium	0.05 mg/m^3 (NIC 0.01 mg/m^3)	Ca[c]	0.2 mg/m^3	Ca	Inhalation, ingestion	Pulmonary edema, dyspnea, cough, tight chest, substernal pain, headache, chills, muscle aches, nausea, diarrhea, anosmia, emphysema, proteinuria	Suspect human carcinogen

TABLE 2-2 (Continued)

OCCUPATIONAL HEALTH GUIDELINES AND TOXICOLOGICAL INFORMATION

Contaminant	ACGIH TLV/TWA (mg/m^3)	NIOSH REL (mg/m^3)	OSHA PEL (mg/m^3)	NIOSH/OSHA IDLH (mg/m^3)	Routes of Exposure	Symptomology (Acute/Chronic)	Carcinogenicity Mutagenicity Teratogenicity
Chromium[d]	0.05 mg/m^3	N/A	N/A	N/A	Inhalation, ingestion skin and/or eye contact perferation; liver/kidney damage; leukocytosis, lekopenia, moncytosis, eosinophilia, eye injury, conjuctivitis, skin ulcer, sensitization dermatitis, fribosis of lungs	Respiratory sytem irritant, nasal septum	Human carcinogen
Gasoline	300 ppm	Ca[e]	300 ppm	NE[f]	Inhalation, Skin and/or eye contact, ingestion	CNS depressant; eyes, nose, and throat irritation dermatitis, headache	Potential carcinogen
Toluene	100 ppm	100 ppm	100 ppm	2,000 ppm	Inhalation, skin, eye absorption; skin/eye contact; ingestion	Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupil; lacrimation, nervousness, muscle fatigue, insomnia, paresthesia, dermatitis	
Ethylbenzene	100 ppm	100 ppm	100 ppm	2,000 ppm	Inhalation, ingestion, eye/skin contact	Irritant to eyes, skin, and respiratory tract, headache, dermatitis, narcosis	
Xylenes[f]	100 ppm	100 ppm	100 ppm	1,000 ppm	Inhalation, skin/eye absorption, skin/eye contact, ingestion	Dizziness, excitement, drowsiness, incoherence; staggered gait; irritant to eyes, nose, and throat, corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	

TABLE 2-2 (Continued)

OCCUPATIONAL HEALTH GUIDELINES AND TOXICOLOGICAL INFORMATION

Contaminant	ACGIH TLV/TWA (mg/m^3)	NIOSH REL (mg/m^3)	OSHA PEL (mg/m^3)	NIOSH/OSHA IDLH (mg/m^3)	Routes of Exposure	Symptomology (Acute/Chronic)	Carcinogenicity Mutagenicity Teratogenicity
Diesel Fuel	100 ppm	100 ppm	100 ppm	1,000 ppm	Inhalation, skin/eye absorption, skin/eye contact, ingestion	Dizziness, excitement, drowsiness, incoherence; staggered gait; irritant to eyes, nose, and throat, corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	
Benzo(a)pyrene	A2	0.2 mg/m^3[c]	0.1 mg/m^3	700 mg/m^3	Inhalation, skin/eye contact	Dermatitis, bronchitis	carginogen
1,1,1-Trichloroethane[f]	350 ppm	350 ppm	350 ppm	1,000 ppm	Inhalation, ingestion, skin/eye contact	Headache, lassitude, CNS depressant, poor equilibrium irritant to eyes and skin, cardiac errhythmia.	
Perchloroethelyne[f]	50 ppm	25 ppm	Ca	500(Ca)	Inhalation, skin/eye absorption, skin/eye contact	Eyes, nose and throat irritant nausea, flush face and neck vertigo, dizziness, incoherence, headache, somnolence, skin erythemia, liver damage	carcinogen

a NIOSH immediately dangerous to life or health (IDLH) notation for treating this compound or element as a potential carcinogen.
b NIOSH designation indicating that an IDLH has not been assigned.
c NIOSH recommendation to reduce exposure to lowest feasible concentration.
d Values provided are for hexavalent chromium.
e Ca = NIOSH considered carcinogen.
f NE = Not established.
NIC Notice of intended changes.

dent will be reported immediately to the USACE and OSHA. Records of all accidents and first-aid treatments will be maintained by the health and safety specialist.

Recordable accidents will be reported on Form ENG 3394 to the CO. The following is a detailed description of a recordable accident as defined in AR 385-40 and USACE supplements. Recordable accidents are those accident Classes A through C, and some types of Class D accidents and occupational illnesses (explained below). Only Class D accidents and occupational illnesses for which a Federal Employees Compensation Act (FECA) claim has been sent to the Department of Labor will be considered recordable to the USACE. Class D accidents dealing with cumulative exposure occupational illnesses (noise induced hearing loss, asbestosis, radiation poisoning, organic solvent exposure, dermatosis, silicosis, etc.) will also be forward to the USACE.

- **Class A Accident.** An accident in which the resulting total cost of property damage and personnel injuries is $500,000 or greater; or an injury or occupational illness resulting in a fatality or permanent total disability.

- **Class B Accident.** An accident in which the resulting total cost of property damage and personnel injuries is $100,000 or more, but less than $500,000; or an injury or occupational illness resulting in permanent partial disability or hospitalization of five or more personnel.

- **Class C Accident.** An accident in which the resulting total cost of property damage and personnel injuries is $10,000 or more, but less than $100,000; or an injury or occupational illness that results in a lost workday case with days away from work.

- **Class D Accident.** An accident in which the resulting total cost of property damage and personnel injuries is less than $10,000, or an injury or occupational illness resulting in a lost workday case, with one or more days of restricted work activity, or a nonfatal case without lost workday.

4.2 Activity Hazard Analysis.

The UST removal activities to be conducted at the site consist of (1) removal and disposal of five 10,000-gallon USTs used to store petroleum hydrocarbons and all associated piping, (2) removal and disposal of all tank contents (water and petroleum products), (3) removal and disposal of petroleum-contaminated soils, and (4) confirmatory soil sampling in the bottom of the UST excavations. The potential hazards of each site activity, and the control measures that shall be implemented to minimize or eliminate them, are discussed below.

- **Removal of the USTs, Tank Contents, and Contaminated Soils.** Hazards associated with removal of the USTs, tank contents, and contaminated soils include potential inhalatory or dermal exposure to site contaminants, noise, heavy equipment, potential confined space entry and possibly heat stress. The work should be engineered to minimize potential personnel exposures to site contaminants (e.g., provisions for dust suppression) and noise. If necessary, this site may be upgraded to EPA Level C protection (per criteria established in Section 7.2). Noise monitoring will be conducted at the site; disposable hearing protective devices will be made available to site personnel (as per

Section 7.4). Heat stress monitoring will be conducted, depending upon ambient conditions, as described in Section 7.3. Potential hazard to these personnel will also be of a physical nature. Site personnel performing these activities shall adhere to the OSHA Construction Industry Standards (29 CFR 1926).

- **Collection of Soil Samples.** The major hazard associated with collection of potentially contaminated materials is potential inhalatory or dermal exposure to site contaminants. The work should be engineered to minimize potential personnel exposures to site contaminants. If necessary, this site may be upgraded to EPA Level C protection (per criteria established in Section 7.2).

- **Tank Cleaning.** Cleaning of the interior of the USTs may, depending on the Contractor, involve confined space entry and exposure to oxygen deficient or explosive atmospheres. These atmospheres are highly hazardous and extreme care must be taken to avoid injury. In addition, there will also be a high potential for dermal exposure to site contaminants. A checklist is included in Paragraph 9.3 which must be completed prior to confined space entry.

4.3 Physical/Mechanical Hazards. Other physical and mechanical hazards expected to be present at the site during excavation and removal of the underground storage tank include:

- Snapping cables, slings and ropes;
- Overhead cranes or other hoists;
- Heavy equipment;
- Moving equipment;
- Sharp objects;
- Loose foundations;
- Open pits, ditches, holes;
- Excessive noise;
- Buried utility lines;
- Energized overhead and underground power lines.

Most of the physical hazards identified will be abated through the use of good construction/excavation safety practices and common sense. Moving heavy equipment will require the use of operators trained and experienced. Equipment checked daily for defects. Foot traffic restricted in areas of operation. Established set of hand signals for laborers assisting in the operation of equipment. Signal persons for heavy equipment operators shall wear apparel marked with a reflectorized or high visibility material. Elimination of noise through the use of wearing ear plugs or muffs.

4.4 General Site Safety Requirements

The following practices should be expressly forbidden during site remediation activities:

- Smoking, eating, drinking, applying chapstick or cosmetics, or chewing tobacco while in the exclusion or contamination reduction zones, or any potentially contaminated area.

- Ignition of flammable materials in the work zone; equipment shall be bonded and grounded, sparkproof, and explosion resistant, as appropriate.

- Contact with potentially contaminated substances. Walking through puddles or pools of liquid, kneeling on the ground, or leaning, sitting or placing equipment on the contaminated soil should be avoided.

- Performance of tasks in the exclusion zone individually; personnel shall work using the "buddy system" at all times.

Personnel should keep the following prudent guidelines in mind when on-site conducting an investigation:

- Hazard assessment is a continual process; personnel must be aware of their surroundings and constantly be aware of the chemical/physical/biological hazards that are present.

- Personnel in the exclusion zone shall be the minimum number necessary to perform work tasks in a safe and efficient manner.

- Team members will be familiar with the physical characteristics of each investigation site, including wind direction, site access, location of communication devices, and safety equipment.

5.0 CONTRACTOR ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

Assignment of responsibilities for development, coordination, and implementation of the contract SSHP is essential for proper administration of the plan's requirements. Implementation of the Contractor SSHP will only be accomplished through an integrated effort of the following Contractor personnel: project engineer, industrial hygienist, and the health and safety specialist.

5.1 Project Engineer (PE)

The PE is responsible to assure that the goals of the UST removal activities are attained in a manner consistent with the Contractor SSHP requirements. He will coordinate with the industrial hygienist and the health and safety specialist to assure that the remedial action goals are completed in a manner consistent with the Contractor SSHP. The PE shall be the primary Contractor contact with the CO.

5.2 Industrial Hygienist (IH)

The IH is responsible for the preparation of the Contractor SSHP. The IH will ensure that the safety plan complies with all federal, state, and local health and safety requirements. If necessary, the IH can modify specific aspects of the Contractor SSHP to adjust for on-site changes that affect safety (any such modifications must also be approved by the CO). The IH will coordinate with the health and safety specialist on all modifications to the Contractor SSHP and will be available for consultation when required. The IH will not necessarily be on-site during remedial activities. The IH will prepare the materials to be

used in the training program and ensure that the health and safety specialist is knowledgeable in all components of the Contractor SSHP.

The IH will have a minimum of three (3) years working experience in the chemical industry and/or chemical waste disposal industry and shall be certified in comprehensive practice by the American Board of Industrial Hygiene (ABIH). The certified industrial hygienist shall have a working knowledge of state and federal occupational safety and health regulations and formal training in occupational safety and health. This individual's name and applicable work experience shall be submitted and approved prior to submittal of the Contractor SSHP.

5.3 Health and Safety Specialist (HSS)

The HSS shall be on-site at all times during work activities, and is responsible for the implementation of the Contractor SSHP. The HSS has the responsibility and authority to halt or modify any working condition, or remove personnel from the site if he considers conditions to be unsafe. The HSS will be the main contact in any on-site emergency situations; he will direct all field activities involved with safety. The HSS is responsible for assuring that all on-site personnel understand and comply with all safety requirements. Except in an emergency, the HSS can modify the Contractor SSHP requirements only after consultation and agreement of the IH.

The Contractor's HSS person(s) shall be required to have one of the following experience and/or education qualifications:

- A degree in engineering or safety in at least a 4-year program from an accredited school and he will have a working knowledge of state and federal occupational safety and health regulations and formal training in occupational safety and health; or

- A legal registration as a professional engineer or a certified safety person and, in addition, shall have been engaged in safety and occupational health for at least one (1) year of experience, of which no less than fifty (50) percent of the time was devoted to safety and occupational health and he will have a working knowledge of state and federal occupational safety and health regulations and formal training in occupational safety and health; or

- A degree other than that specified above and, in addition, shall have been engaged in safety and occupational health for at least three (3) years of which no less than fifty (50) percent of the time each year was devoted to safety and occupational health and he will have a working knowledge of state and federal occupational safety and health regulations and formal training in occupational safety and health; or

- Qualified experience in safety and occupational health for at least five (5) years of which no less than fifty (50) percent of the time each year was devoted to safety and occupational health and he will have a working knowledge of state and federal occupational safety and health regulations and formal training in occupational safety and health.

- The HSS shall be certified in First Aid and CPR. These certifications shall be kept current for the duration of the project. However, in any of the above, first aid work shall not be considered as creditable experience (based on EFARS 52.2/9303).

5.4 Field Staff

All field staff, both contractor and subcontractor personnel, are responsible for understanding and complying with all requirements of the Contractor SSHP. Field staff will be instructed during each daily safety meeting to bring all perceived unsafe site conditions to the attention of the HSS.

6.0 TRAINING

The Contractor shall include in the SSHP, an employee training program complying with, but not necessarily limited to those requirements specified approved by the Corps of Engineers in EM 385-1-1 and OSHA 29 1910.120, CFR that includes training on hazardous waste operations, OSHA training, PPE use, heavy equipment operator, confined space entry, visitor, and follow-up training. All site personnel who will perform work in either contamination reduction or exclusion zones (as defined in Sections 11.2 and 11.3) during the UST removal project shall have completed this training. A summarization of these requirements is as follows:

> At the time of mobilization, all Contractor personnel shall have completed at least 40 hours of off-site instruction in health and safety issues associated with hazardous substance site work. Additionally, these personnel shall have a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. On-site Contractor management personnel shall have at least 8 additional hours of specialized training on managing such operations. Eight hours of annual site refresher health and safety training shall be completed by Contractor personnel who completed the 40-hour course more than 1 year previous to project mobilization.

To ensure that all site personnel understand the hazards associated with site operations, a tailgate safety meeting shall be conducted on a daily basis, whenever new personnel arrive at the site, and as site conditions change. The HSS shall assure that all personnel have received the required training prior to working on-site. The following is an outline of the major site-specific topics that should be discussed by the HSS, or the IH, during tailgate training for the ATGAS UST removal work:

- General Site Safety Responsibilities
- Medical Surveillance Program
- Review of the Contractor SSHP
- Potential Chemical/Physical Hazards
- Personnel Protective Equipment/Respiratory Protection

flammable vapors emanating from such sources. Surfaces of a tank that have been in contact with leaded gasoline should be scraped down to bare metal over any area that might be heated excessively by welding or by other operations. As an alternative to cleaning down to bare metals, welders may use supplied-air respiratory equipment or a welder's facepiece designed for use with a hose mask through which fresh air is supplied. Where hot work is to be performed, fire extinguishers must be immediately available.

10.5 Excavation Safety

All excavating work shall be conducted in strict conformance with, at a minimum, EM 385-1-1 and 29 CFR 1926.650 through 29 CFR 1926.653, including requirements for continuously sloping excavations to 1-1/2 to 1 (34o) angle of repose, unless the Contractor tests and characterizes the soils. If the Contractor tests and categorizes the soils, an angle of repose, as indicated below, may be utilized.

APPROXIMATE ANGLE OF REPOSE
for Sloping of Sides of Excavations

Type of Soil	Angle of Repose
Stable Rock	Vertical (90°)
Type A(1)	3/4:1 (53°)
Type B(2)	1:1 (45°)
Type C(3)	1-1/2:1 (34°)

NOTES:

(1) Type A means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf). Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam, and in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are considered type A. However, NO soil is Type A if the soil is fissured; or the soil is subject to vibration from heavy traffic, pile driving, or similar effects; or the soil has been previously disturbed; or the soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4:1) or greater; or the material is subject to other factors that would require to be classified as a less stable material.

(2) Type B means cohesive soils with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf (tons per square foot); or granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam and in some cases, silty clay loam and sandy clay loam; or previously disturbed soils except those which would otherwise be classed as Type C soils; or soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or dry rock that is not stable; or material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4:1), but only if the material would otherwise be classified as Type B.

(3) Type C means cohesive soils with an unconfined compressive strength of 0.5 tsf or less; or granular soils including gravel, sand, and loamy sand; or submerged soil or

soil from which water is freely seeping; or submerged rock that is not stable; or material in a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4:1).

10.5.1 Overhead Utilities. Clearances to adjacent overhead transmission and distribution electrical lines shall be sufficient for the movement of vehicles and operation of construction equipment. The requirements stated in EM 385-1-1, 29 CFR 1926, and the National Electric Safety Code shall be followed by the Contractor.

10.6 Sanitation

10.6.1 Washing Facilities. The Contractor shall provide washing facilities in the SZ consisting of cold running water, towels, and soap for men and women as necessary (see also paragraph 12: Personnel Hygiene and Decontamination of this section).

10.6.2 Drinking Water. The Contractor shall provide potable water in the SZ work areas and shall:

- Clearly mark containers of potable water;
- Ensure potable water containers are not used for any other purpose;
- Keep drinking cups in sanitary receptacles;
- Provide receptacles if disposable cups are provided; and
- Ensure there are no cross-connections between potable and nonpotable supplies.

10.6.3 Toilets. The Contractor shall provide at least 1 toilet, and if there are more than 20 employees at least 1 toilet seat and 1 urinal per 40 workers.

10.6.4 Lunch and Break Area. The Contractor shall provide a break and lunch area in the SZ and shall ensure the area is kept sanitary.

11.0 SITE CONTROL MEASURES

Site control requires the establishment of a regulated area, designated work zones, an evacuation protocol, and site security. The Contractor's SSHP shall include his plan for site control.

11.1 Regulated Area(s)

To minimize the transfer of potential hazardous substances from the site, contamination control procedures are needed. Two general methods shall be used: establishing site work zones (exclusion, contamination reduction, support), and personnel/equipment decontamination. The site must be controlled to reduce the possibility of: (1) exposure to any contaminants present; and (2) their transport by personnel or equipment from the site. The possibility of exposure or translocation of substances will be reduced or eliminated in a number of ways, including:

- Setting up physical barriers to exclude unnecessary personnel from the general area.
- Minimizing the number of personnel on-site consistent with effective operations.
- Establishing work zones around each site work area.
- Establishing control points to regulate access to work zones.
- Implementing appropriate decontamination procedures.

Safety procedures for preventing or reducing the migration of contamination require the delineation of zones on the site where prescribed operations occur. Movement of personnel and equipment between zones and on to each site will be limited by access control points. After confirming the appropriate level of personal protection for site entry and determining the general wind direction, site work zones will be established. Three contiguous zones are required for Level C and D operations (Figure 11-1). The ATGAS site will be clearly delineated with physical barriers to define the work area and to identify entry and exit points. Personnel on-site will use the "buddy system" and will maintain communication or visual contact between team members at all times.

11.2 Work Zones

- **Zone 1:** Exclusion Zone (work zone)
- **Zone 2:** Contamination Reduction Zone
- **Zone 3:** Support Zone

11.2.1 Zone 1 – Exclusion Zone. The exclusion zone, or work zone, is the zone where contamination could occur. All personnel entering the exclusion zone must wear prescribed personal protection equipment. The outer boundary of the work zone will be established by visually surveying the site and determining the distances needed to prevent fire or an explosion from affecting personnel outside the zone, the physical area necessary to conduct site operations, and the potential for contaminants to be blown from the area. The area will be of sufficient size to include on-site vehicles and equipment. Once the boundary has been determined, it shall be defined with continuous red surveyors tape. During subsequent site operations, the boundary may be modified and adjusted by the HSS as more information becomes available. Only personnel who have been trained and who don the prescribed personal protection equipment will be permitted to enter the exclusion zone.

11.2.2 Zone 2 – Contamination Reduction Zone. Between the exclusion zone and the support zone, a contamination reduction zone will be established. This zone provides a transition between contaminated and clean zones. Zone 2 serves as a buffer to further reduce the probability of the clean zone becoming contaminated or being affected by other existing hazards. It provides additional assurance that the physical transfer of contaminants on personnel, equipment, or in the area is limited through a combination of decontamination and the distance between exclusion and support zones.

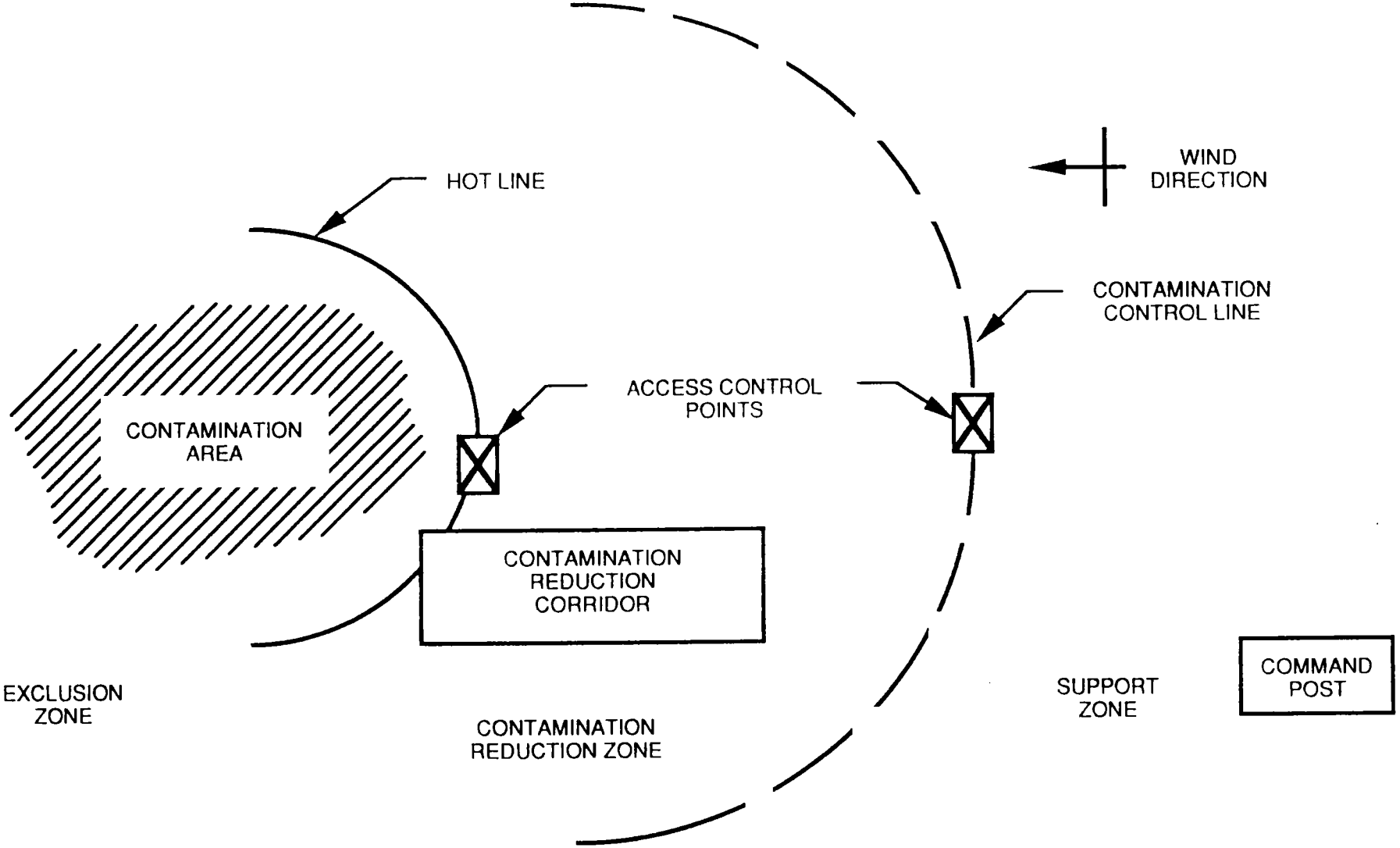


DIAGRAM OF SITE WORK ZONES

FIGURE 8-1

Initially, the contamination reduction zone will be considered to be a non-contaminated area. At the boundary between the exclusion and contamination reduction zones, decontamination stations will be established, one for personnel and one for heavy equipment. Exit from the exclusion zone will be through a designated decontamination corridor.

As operations proceed, the area around the decontamination station may become contaminated, but to a much lesser degree than the exclusion zone. On a relative basis, the amount of contaminants will decrease from the "hotline" to the support zone, due to the distance involved and the decontamination procedures used. The "contamination control line" separating the contamination reduction zone and the support zone will be physically marked.

11.2.3 Zone 3 - Support Zone. The support zone, the outermost part of the site, will be considered a non-contaminated or clean area. Support equipment (command post, safety vehicle, etc.) is located in this area. Since normal work clothing are appropriate within this zone, potentially contaminated personnel clothing, equipment, and samples are not permitted.

The location of the command post and other support facilities in the support zone depends on a number of factors, including:

- Accessibility – topography; open space available; locations of roads; or other limitations.
- Wind direction – preferably the support facilities should be located upwind of the exclusion zone. Shifts in wind direction and other conditions may be such that an ideal location based on wind direction alone does not exist.
- Resources – water; mobile telephone; or other communication equipment.

Access to the contamination reduction zone from the support zone is through a controlled access point. Personnel entering the contamination reduction zone to assist in decontamination must wear the prescribed personnel protective equipment. Re-entrance into the support zone requires removal of any protective equipment worn in the contamination reduction zone.

11.3 Emergency Protocol

The Contractor shall take the following actions to minimize chemical/physical hazards and operational mishaps:

- Evacuation routes from each site shall be established and communicated to all personnel during the daily safety meeting prior to work start-up in any area.
- The Contractor supervisor in the exclusion zone shall carry a warning device of sufficient loudness to be heard by workers above site work noises. The IH writing the SSHP shall determine what signals will be

used in the event of fire, hazardous substance spill, vapor release, or other hazardous event.

- The HSS is responsible to assure the availability of communication devices at each investigation site for general and emergency use.

12.0 PERSONAL HYGIENE AND DECONTAMINATION

Establishment of decontamination procedures for personnel and equipment is necessary to control contamination and to protect field personnel during the following site activities: (1) removal of the USTs, associated piping, and contaminated soils; (2) cleaning out the USTs; and (3) collection of soil samples from tank excavations. When decontamination is necessary, it will consist of the following:

- An area within the contamination reduction zone will be designated as the contamination reduction corridor (CRC) (see Figure 8-1). The CRC controls access into and out of the exclusion zone and confines personnel decontamination activities to a limited area. The size of the corridor depends on the number of stations in the decontamination procedure, overall dimensions of work control zones, and amount of space available. Boundaries will be conspicuously marked, with entry and exit restricted. The far end is a "hotline," the boundary between the exclusion zone and the contamination reduction zone. Personnel exiting the exclusion zone must go through the CRC. Another corridor will be required for the entrance and exit of heavy equipment needing decontamination. The corridor will be dedicated to decontamination activities only.

- When exiting the exclusion zone, personnel will remove chemical resistant boots, coveralls, and other gloves only at the specified decontamination station. When in use, air purifying respirators shall be removed last.

- Personnel shall be instructed in proper decontamination technique. This entails removal of protective clothing in an "inside-out" manner. Removal of contaminants from clothing or equipment by blowing, shaking, or any other means that may disperse material into the air is prohibited.

- All personal protective clothing that has been removed shall remain at the decontamination station. Personal protective clothing will be decontaminated prior to redonning. If Tyvek coveralls are used, they will be discarded after each usage and a new set donned prior to re-entering the Exclusion Zone. At the conclusion of work in a site exclusion zone, all protective equipment must be placed in plastic bags prior to disposal.

- Non-disposable personnel protective clothing and respirators, monitoring equipment, sampling supplies, etc., will be maintained adjacent to the CRC. Personnel must don their protective equipment and enter the exclusion zone through a separate point at the "hotline."

- Personnel will not be permitted to exit the regulated work area until contaminated clothing and equipment have been removed, and employees have washed their hands and face with soap and water.

- All employees will wash their hands and face with soap and water before eating, drinking, smoking, or applying cosmetics. These activities will be restricted to the designated rest area(s) in the support zone.

13.0 EQUIPMENT DECONTAMINATION AND DISPOSAL OF CONTAMINATED MATERIALS

Equipment that may require decontamination includes tools, heavy equipment (e.g., vehicles), sampling devices, and certain protective equipment. All materials and equipment used for decontamination must be disposed of properly. Disposable clothing, tools, buckets, brushes, and all other equipment that is contaminated will be secured in DOT-approved 55-gallon drums or other containers and labeled. Clothing that will be reused, not completely decontaminated on-site, will be secured in plastic bags before being removed from the site. Contaminated wash water solutions shall be transferred in DOT-approved 55-gallon drums for storage at the designated on-site storage area. The Contractor shall provide an appropriate equipment decontamination procedure, including specific methodologies in his SSHP. This procedure is subject to the approval of the CO.

All potential contaminated soils will be stockpiled pending chemical analysis. Those soils requiring disposal will be segregated on-site; clean soils may be used as backfill material by the Contractor.

13.1 Decontamination During Medical Emergencies

If prompt life-saving first-aid and/or medical treatment is required, decontamination procedures should be omitted. On-site personnel will accompany contaminated victims to the medical facility to advise on matters involving decontamination.

Life-saving care shall be instituted immediately without considering decontamination. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Chemical-resistant clothing can be cut away. If the outer contaminated garments cannot be safely removed, the individual shall be wrapped in plastic, rubber, or blankets to help prevent contaminating the inside of ambulances and/or medical personnel. Outer garments are then removed at the medical facility. No attempt will be made to wash or rinse the victim, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material that could also cause severe injury or loss of life. For minor medical problems or injuries, the normal decontamination procedure will be followed.

Heat-related illnesses range from heat fatigue to heat stroke. Heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention. Unless the victim is obviously contaminated, decontamination should be omitted or minimized, and treatment begun immediately.

For chemical inhalation exposure cases, treatment can only be performed by a qualified physician. If the contaminant is on the skin or in the eyes, immediate measures will be taken on-site to counteract the substance's effect. First-aid treatment consists of flooding the affected area with copious amounts of water. The HSS must assure that an adequate supply of running water or a portable emergency eyewash is available on-site. The

Contractor shall have a portable eyewash on-site with a 5-gallon minimum capacity (15-minute duration).

When protective clothing is grossly contaminated, contaminants can possibly be transferred to treatment personnel and cause an exposure. Unless severe medical problems have occurred simultaneously with personnel contamination, the protective clothing should be carefully removed.

14.0 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

The Contractor shall provide for emergency response equipment and first aid arrangements. As a minimum, the below listed supplies shall be immediately available for on-site use:

- First Aid equipment and Supplies. The equipment and supplies are to be approved by the Contractor's consulting physician.
- Emergency eyewash station and shower which meet the approval of the American National Standards Institute (ANSI) standard Z-358.1, Emergency Eyewash and Shower Equipment.
- Emergency use respiratory equipment sufficient to protect field personnel in worst-case conditions.
- Spill control material and equipment.
- Type ABC fire extinguisher, 10 pound capacity. A minimum of two fire extinguishers shall be available.

15.0 EMERGENCY RESPONSE PLAN AND CONTINGENCY

The Contractor shall develop an emergency response and contingency plan for on-site emergencies, as specified in 29 CFR 1910.120(l), which should address at a minimum:

- Pre-emergency planning.
- Personnel roles, lines of authority, training and communication.
- Emergency recognition and prevention.
- Safe distances and places of refuge.
- Site security and control.
- Evacuation routes and procedures.
- Decontamination.
- Emergency medical treatment and first aid.
- Emergency alerting and response procedure.
- Critique of response and follow-up.
- Personal protective equipment and emergency equipment.

15.1 Spill and Discharge Control. The Contractor shall develop (as part of the SSHP), implement, maintain, supervise, and be responsible for a comprehensive Spill and Discharge Control Plan as specified in SECTION: SPILL CONTROL. The plan shall provide contingency measures for potential spills and discharges from handling and transportation of contaminated soils.

Notification of Spills and Discharges. If the spill or discharge is reportable, and/or human health or the environment are threatened, the Contractor shall notify the National Response Center, the State, and the Contracting Officer, as soon as possible.

Decontamination Procedures. Decontamination procedures may be required after clean-up to eliminate traces of the substance spilled or reduce it to an acceptable level, as determined by the CO. Complete clean-up may require removal of contaminated soils. Personnel and equipment decontamination shall occur as specified in paragraph: Decontamination of this section.

16.0 HEAT/COLD STRESS MONITORING

16.1 Heat Stress Monitoring

The stress of working in a hot environment can cause a variety of illnesses including heat exhaustion or heat stroke; the latter can be fatal. Use of personal protective equipment can significantly increase heat stress. To reduce or prevent heat stress the contractor shall, as required when ambient temperatures exceed 70°F, implement scheduled rest periods and require controlled beverage consumption to replace body fluids and salts. The following procedures and action levels shall be used, depending upon ambient site conditions, by the Contractor to monitor potential heat stress:

- **Heart Rate.** Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate exceeds 110 beats per minute at the next rest period, shorten the following work cycle by another one-third and also monitor oral temperature.

- **Oral Temperature.** Use a clinical thermometer (3 minutes under the tongue) to measure the oral temperature at the end of the work period (before drinking). If oral temperature exceeds 99.6°F, shorten the next work cycle by one-third without changing the rest period. If oral temperature exceeds 99.6°F at the beginning of the next rest period, shorten the following work cycle by one-third. Field team members shall not be allowed to wear Level C protection when oral temperatures exceeds 100.6°F.

Personnel shall be trained to recognize the symptoms of heat stress and the appropriate action to take upon recognition. Even though physiological monitoring is not always necessary, it is essential that personnel understand the significance of heat stress and its recognition. The Contractor should refer to the section on heat stress in the NIOSH/OSHA/ USCG/EPA document, "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," published by the U.S. Department of Health and Human Services in October 1985.

16.2 Cold Stress

Cold injury (frostbite and hypothermia) and impaired ability to work are dangers at low temperatures and when the wind-chill factor is low. To guard against them: wear

appropriate clothing; have warm shelter readily available; carefully schedule work and rest periods, and monitor workers' physical conditions. ACGIH, Threshold Limit Values, and Biological Exposure Indices for 1989-1990 shall be consulted for monitoring of workers' physical conditions and for establishing a work and rest schedule.

17.0 LOGS, REPORT, RECORDKEEPING

The Contractor shall maintain logs and records that relate to all aspects of the Contractor SSHP implementation. Documentation, at minimum, shall include:

- Training log documentation of the 40 hours and three day initial training.
- Copies of Medical Certificates for site personnel.
- OSHA Records. Required OSHA records are listed in Table 1, attached.

17.1 Daily Log and Safety Inspection Report

The daily log and safety inspection report shall include practices and events that affect safety and health, safety and health discrepancies encountered, and safety and health issues brought to the supervisor's attention. Each entry shall include:

- Area (specific zone);
- Number of employees in each area;
- Equipment being used in each area;
- A daily record of all first aid treatments not otherwise recordable
- Special health and safety issues notes;
- Daily tailgate safety meeting forms.
- HSS signature and date.

17.2 Weekly Report

The weekly report shall be prepared by the HSS, this report shall provide at a minimum:

- A summary sheet covering the range of work accomplished during the week;
- Copies of the daily health and safety inspection reports;
- Instances of job-related injuries and illnesses;
- Results of personal/air monitoring and screening performed during the previous week;

- Copies of correspondence; and
- IH/HSS signature and date.

17.3 Phase-Out Report

The phase-out report is written by the Contractor at the completion of work. The report shall include:

- A summary of the project;
- A summary of health and safety activities reported throughout the duration of the project;
- Records of all occupational illnesses and injuries associated with the project.
- Copies of the final physical and medical records and the physician's final written opinion;
- Copies of the air monitoring field log; (which shall include monitoring location type of monitoring, calibration results, monitoring results, temperature, barometric pressure, and relative humidity, wind conditions and initials of person monitoring);
- Copies of all air monitoring calibration records;
- Copies of all chain-of-custody records maintained for air samples; and
- Date and place;
- Copies of all raw data collection sheets used during air monitoring activities.
- The phase-out report shall be reviewed and approved by the project CIH prior to submittal to the CO.

- Personnel/Equipment Decontamination
- Emergency Assistance Network

All Contractor personnel shall be required to sign and date a document acknowledging that he has read and understood the Contractor SSHP and attended the daily tailgate safety meetings. Copies of completed personal acknowledgements should be submitted by the Contractor to the CO.

7.0 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment may be required during the course of the UST removal work at Fort Story. Selection will be based primarily on hazard assessment data and work task requirements. Specific levels of personal protection mandated for work at the ATGAS site are as follows:

- (1) **Excavation of USTs and Contaminated Soils.** Modified Level D with provision to upgrade to level C.
- (2) **Cleaning USTs.** Modified Level D with provisions to upgrade to Level C (or Level B if tank entry is required).
- (3) **Sampling of Soil in Tank Excavation.** Modified Level D with provisions to upgrade to level C.

The Contractor shall be required to provide all on-site personnel with appropriate personal safety equipment and protective clothing, and shall ensure that all safety equipment and protective clothing is kept clean and well maintained. The Contractor shall be required to maintain an inventory of personal protective equipment for four governmental personnel, and up to two site visitors per day.

7.1 Modified Level D Personal Protective Equipment

Personnel working in an exclusion zone, as defined in Section 8.1, shall wear as a minimum:

- Dedicated work uniform (such as coveralls, cotton or disposable chemical resistant [standard Tyvek]).
- Boots, leather (with chemical resistant overboots) or chemical resistant, steel toe meeting ANSI Standard Z41-1983, Safety-Toe Footwear, Classification 75 (boot type assigned by the IH).
- Eye protection such as faceshields, goggles, and safety glasses shall meet ANSI Standard Z87.1-1979, "Practice for Occupational and Educational Eye and Face Protection."
- Hardhat meeting ANSI Standard Z89.1-1986, Class A, B, and C.
- Gloves, chemical resistant (nitrile and/or latex-neoprene) as the outer and Best Manufacturer N-Dex 7005 disposable nitrile as the inner glove.

- Hearing protection that has a noise reduction rating (NRR) of at least 28 and shall meet ANSI Standard S3.19-R-1979, "Method for the Measurement of Real Ear Protection and Physical Attenuation of Earmuffs."

7.2 Level C Personal Protective Equipment

When air monitoring information dictates that a particular site be upgraded to Level C protection, personnel shall wear as a minimum:

- Full-face air purifying respirators, NIOSH/OSHA approved, equipped with cartridges for combination organic vapors, dusts, and mists.
- Coveralls, disposable chemical resistant (polyethylene coated Tyvek).
- Boots, leather (with chemical resistant overboots) or chemical resistant, steel toe meeting ANSI Standard Z41-1983, Safety-Toe Footwear, Classification 75 (boot type assigned by the IH).
- Eye protection such as faceshields, goggles, and safety glasses shall meet ANSI Standard Z87.1-1979, "Practice for Occupational and Educational Eye and Face Protection."
- Hardhat meeting ANSI Standard Z89.1-1986, Class A, B, and C.
- Gloves, chemical resistant (nitrile and/or latex-neoprene) as the outer and Best Manufacturer N-Dex 7005 disposable nitrile as the inner glove.
- Hearing protection that has a noise reduction rating (NRR) of at least 28 and shall meet ANSI Standard S3.19-R-1979, "Method for the Measurement of Real Ear Protection and Physical Attenuation of Earmuffs."

7.3 Confined Space

The Contractor shall assure that personnel conducting confined space entry work have the necessary training. The Contractor shall access the need for and requisite PPE for each necessary confined space application. NIOSH-approved self-contained breathing apparatus or NIOSH-approved airline respirators equipped with a five-minute emergency air supply (egress bottle) with Grade D Breathing Air are the only respirators approved for use in untested confined spaces or spaces known to contain an atmosphere immediately hazardous to life and health. Impervious gloves, boots, and apparel are required for work with contaminants which are absorbed through the skin. Breathing air and supply systems shall meet at least the requirements of 29 CFR 1910.134. The compressor for supplying breathing air shall be equipped with the necessary safety and standby devices. Compressors shall be constructed and situated so as to avoid entry of contaminated air into the system and suitable in-line air purifying sorbent beds and filters installed to further assure breathing air quality. A receiver of sufficient capacity to enable the respirator to escape from a contaminated atmosphere in event of compressor failure, and alarms to indicate compressor failure and overheating shall be installed in the system. If an oil-lubricated compressor is used, it shall have both high-temperature and carbon monoxide alarms installed. Air line couplings shall be incompatible with outlets for other gas systems

to prevent inadvertent servicing of air line respirators with nonrespirable gases. If breathing air is to be used on this project, the Contractor shall provide to the CO prior to initial entry onto the work site a certification statement that breathing air has been tested within the previous 6 months and meets Grade D specifications, as described in CGA Specification G-7.1-1966.

7.4 Respirator Selection and Fit Test

Prior to site work in Level C protection, the HSS or the IH is responsible to assist in the selection and fit testing of air purifying respirators to be used by site personnel. All respiratory equipment usage shall be in compliance with the requirements of the OSHA Respiratory Protection Standard (29 CFR 1910.134). The HSS shall maintain documentation of the size, brand, and model number of air purifying respirator with which each site worker has achieved a successful face seal fit.

8.0 MEDICAL SURVEILLANCE PROGRAM

Establishment of a medical surveillance program is essential for the protection of site personnel. The purpose of the program is threefold:

- Establishing a baseline picture of health against which future changes can be measured;
- Identifying any underlying illnesses or conditions that might be aggravated by chemical exposures or job activities (i.e., use of respiratory protective equipment); and
- Recognizing any abnormalities at the earliest opportunity, so that corrective measures can be implemented.

8.1 Medical Screening and Health Surveillance

All on-site personnel who will perform work in the contamination reduction zone or exclusion zone (as described in Sections 8.2 and 8.3) shall have an initial baseline medical examination prior to project mobilization. If one year has elapsed since an initial examination, updated medical history and examination will be required. All applicable USACE, Contractor, and subcontractor personnel will be subject to this medical examination requirement.

Medical examinations should be conducted under the direction of a qualified physician, preferably certified by the American Board of Preventive Medicine in Occupational Medicine, and conducted in accordance with the recommendations for medical surveillance as stated in the NIOSH/OSHA/USCG/EPA document, "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," published by the U.S. Department of Health and Human Services in October 1985. The Contractor physician shall be provided a copy of 29 CFR 1910.120 by the Contractor.

The name, resume, and a statement of commitment from the physician selected by the Contractor shall be provided to the CO for review and approval. The Contractor shall provide a copy of the physician's written opinion about employees' ability to perform hazardous remediation work before work begins. If any of the Contractor's personnel

develop a lost time injury or illness during the period of the work at the ATGAS site, a written statement signed by the physician must be submitted to the CO prior to allowing the employee to return to work.

8.2 Emergency Medical Assistance and First-Aid Equipment

In accordance with 29 CFR 1910.120(l), the Contractor will have developed an emergency response and contingency plan that establishes site evacuation routes and an emergency medical assistance network (see also Section 8.4, Emergency Protocol). The Fire Department ambulance service, and clinic or hospital emergency room shall be identified and phone numbers for these services posted in a conspicuous place at the project site. Table 8-1 tentatively identifies appropriate medical assistance. Additionally, a vehicle shall be available on-site during all work activities to transport injured personnel to the identified emergency medical facilities. A map and directions indicating the fastest route to the clinic/hospital shall also be posted.

The HSS shall be certified to render first-aid and cardiopulmonary resuscitation (CPR) prior to the initiation of field activities. A first-aid kit shall be available at the site for use by trained personnel. A supply of freshwater or a portable emergency eye wash with a minimum 5-gallon capacity and 15-minute duration shall be available at the work site. The

TABLE 8-1

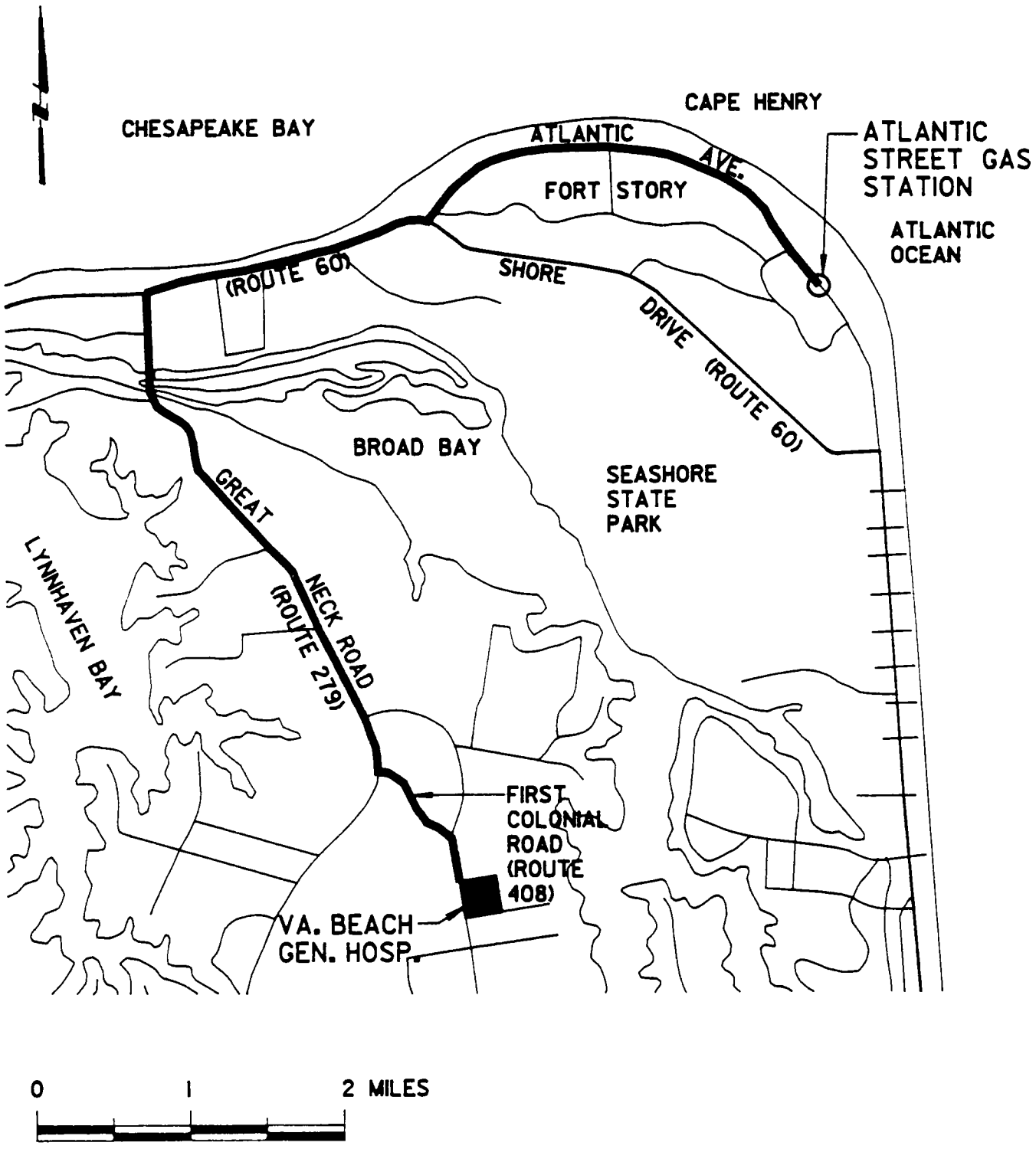
EMERGENCY MEDICAL ASSISTANCE INFORMATION

Fort Story Base Emergency Numbers	
Fort Story Ambulance	804-422-7141
Fire Protection Service	804-422-8862
Off-Base Medical Facilities	
Virginia Beach General Hospital First Colonial Road Virginia Beach, Virginia	804-481-8000 (general) 804-481-8262 (emergency)

Directions to Hospital:

Figure 8-1 provides a map to the nearest off-base medical facility, Virginia Beach General Hospital.

From the ATGAS site, take Atlantic Avenue west to the Base main gate. Turn right on Route 60 (Shore Drive). Drive approximately 1.25 miles to Route 279 (Great Neck Road). Turn left, go approximately 2.5 miles to Route 408 (First Colonial Road). Turn left on First Colonial Road and proceed approximately 1 mile to Virginia Beach General Hospital on the left.



EMERGENCY MEDICAL LOCATION MAP

FIGURE 5-1

IH or HSS shall notify the medical facility to be used in emergencies of the approximate duration of work at the site and provide a list of contaminants expected to be encountered prior to beginning work at the site.

9.0 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Occupational health monitoring is essential in considering the appropriate hazard control measures that must be implemented during the site activities; it involves characterization of the chemical, physical, and other safety hazards at the site. Hazard assessment must be conducted as an on-going process.

9.1 General

The Contractor shall include in the SSHP an air sampling and screening program for all UST site operations. The program shall establish reporting requirements and notification procedures. Sampling and screening shall be under the direction of the IH or HSS. Air monitoring shall be performed to assess the degree of exposure to hydrocarbon vapors during remedial operations and to confirm the adequacy of the level of personal protective equipment being used. Personal monitoring shall be required if an employee develops symptoms indicating possible exposure to hazardous substances, if the examining physician determines that more frequent surveillance is necessary, or if increased sampling frequency is required by the IH in coordination with the HSS. Modifications of the programs shall have the concurrence of the CO. The Contractor shall sample and screen air quality to establish:

- Breathing zone (BZ) concentrations of toxic substances;
- Levels of oxygen, flammable materials, and toxic substances in confined spaces, how work areas, and in the atmosphere;
- Concentrations of air contaminants migrating off the site.

9.2 Monitoring Requirements

9.2.1 Air Monitoring. The main objective of atmospheric monitoring is to assess potential inhalatory hazards to site personnel. Data obtained can also be used to assess potential detectable off-site releases of contaminants. Work areas shall be monitored for organic vapors with direct-read sampling devices.

- **Direct Read Monitoring.** The HSS or IH shall utilize either a photoionization detector (PID)/flame ionization detector (FID) and a combustible gas indicator (CGI)/oxygen meter (OM) for field determination of appropriate levels of personal protection. PIDs shall be equipped with 10.2 eV or 10.6 eV probe. The PID/FID and CGI/OMs used during the project shall be calibrated three times daily: before work begins in the morning, before work resumes after lunch, and at the end of the day.
- **Action Levels.** Organic vapor levels will be measured upwind of each work area to determine the background reading. Initially, all Contractor

personnel will be equipped with EPA Level D protective clothing. The action level (PID or FID reading) for upgrading to Level C protective equipment at the WW II Atlantic Street Gas Station work area will be established by the IH prior to beginning work and will be included in the SSHP. Action levels for upgrading PPE or ceasing field activities include the following: a continuous reading of 5 meter units (MU, essentially parts per million [ppm]) - upgrade from modified Level D to Level C; a continuous reading of 25 MU - evacuate site; a combustible gas indicator reading of greater than 10 percent of the LEL - cease work and evacuate the site; an oxygen meter reading of less than 20 percent oxygen or greater than 22 percent oxygen - cease work and evacuate the site. The CO will review and approve Contractor action levels and shall also be advised of any site conditions that require personnel to upgrade to Level C protection.

The Contractor shall also establish a site evacuation action level, as discussed above, based on the results of PID/FID and combustible gas/oxygen monitoring. If the evacuation action level is exceeded, the work area will be evacuated and site activity will not resume until the Contractor PE discusses the situation with the CO and a course of action is agreed upon.

- **Frequency of Monitoring**. The WW II Atlantic Street Gas Station work site(s) shall be monitored initially with a FID or PID to determine a site background level, and then during work activities. Measurements shall be taken in the worker's breathing zone at least every half hour during the following work activities: (1) removal of the existing USTs and potential contaminated soil, (2) collection of soil samples from the tank excavation, and (3) cleaning of USTs. All air monitoring data shall be recorded in a permanent field log.

  The Contractor shall utilize benzene colorimetric tubes to monitor for benzene exposure levels every one-half hour during work activities specified in Paragraph 7.2.3. All air monitoring data shall be recorded in a permanent field log. The Contractor IH shall use the colorimetric tube results to supplement the results of the PID/FID monitoring and revise the action levels for upgrading personal protective equipment, as necessary. Any revisions to the action levels shall be reviewed and approved by the CO.

9.3 Confined Space Entry

A confined space refers to a space which by design has limited openings for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. The following are definitions of Class A and B confined space and a check list of considerations for entry, working in and exiting confined spaces.

- **Class A.** Immediately dangerous to life - rescue procedures require the entry of more than one individual fully equipped with life support equipment - maintenance of communication requires an additional standby person stationed adjacent to the confined

space. Oxygen content - 16% or less, or greater than 25%. Flammability Characteristics - 20% or greater of LEL.

- **Class B.** Dangerous, but not immediately life threatening - rescue procedures require the entry of no more than one individual fully equipped with life support equipment - indirect visual or auditory communication with workers. Oxygen content - 16.5% to 19.5%, or 21.5% to 25%. Flammability Characteristics - 10% - 19% LEL. Toxicity is greater than contamination level, referenced in 29 CFR Part 1910 Sub Part Z - less than Immediately Dangerous to Life and Health (IDLH).

The following is a check list of considerations for entry, working in, and exiting confined spaces.

1. Permit _____
2. Atmospheric Testing _____
3. Monitoring _____
4. Medical Surveillance _____
5. Training of Personnel _____
6. Labeling and Posting _____
7. Preparation
   - Isolate/lockout/tag _____
   - Purge and ventilate _____
   - Cleaning Processes _____
   - Requirements for special equipment/tools _____
8. Procedures
   - Initial plan _____
   - Standby _____
   - Communications/observation _____
   - Rescue _____
   - Work _____
9. Safety Equipment and Clothing
   - Head Protection _____
   - Hearing Protection _____
   - Foot Protection _____
   - Body Protection _____
   - Respiratory Protection _____
   - Safety Belts _____
   - Lifelines, harness _____
10. Rescue Equipment _____
11. Recordkeeping/Exposure _____

9.4 Fire/Explosions

Fuel (flammable vapors and gases), air (oxygen), and heat (a source of ignition) are elements necessary to cause a fire or explosion. Each underground storage tank to be removed was used to store flammable liquids. CGIs are calibrated to indicate the percentage of the lower flammable limit of vapors present in the mixture. Although a CGI reading of zero is preferable, a concentration not exceeding 10% of the lower explosive limit (LEL) will provide ample safety for performing work. Tank vapors should be checked frequently even if initial measurements indicate airborne quantities are within

acceptable limits. Flammable mixtures may be ignited by many ignition sources, including open flames, gasoline engines, diesel engines, lightning, electrical shorts in worn or defective extension cords, and sparks. Spark sources include electrical lamps, power tools, fixtures, switches, nonexplosion-proof appliances, welding, and static electricity. Because of the possibility of fire and explosion at the site, portable fire extinguishers will be readily available (within 100 feet) to field personnel.

9.5 Purging, Ventilating/Vapor-Freeing

Environmental control within a confined space is accomplished by purging and ventilating/vapor-freeing. The methods used will be determined by the potential hazardous that arise due to the product stored or produced, suspected contaminants, the work to be performed, and the design of the confined space. During the purging process, the vent line should remain connected until the tank is purged. Temporarily plug all other tank openings so that all vapors will exit through the vent line during the vapor-freeing process. During the vapor-freeing operation, the presence of personnel on or adjacent to the tank should be minimized. Rich mixtures, greater than the upper explosive limit (UEL), may ignite and burn when diluted with outside air at tank openings. A rich mixture may remain in a tank after the liquid has been removed. When being vapor-freed by admission of air, tanks containing a rich vapor space will be in the flammable range sometime during the ventilation process. Vapors that escape from openings in a tank are usually heavier than air. If released near ground level, they may travel along the ground a considerable distance from the tank. During the tank vapor-freeing operation, all sources of ignition in the tank or in the vicinity of the tank should be eliminated. After the tank has been freed of vapors and before it is removed from the excavation, plug or cap all accessible holes. One plug - 1/8" vent hole to prevent tank from being subjected to excessive differential pressure caused by temperature changes. The tank should always be positioned with this vent plug on top of the tank during subsequent removal, transport, and storage.

9.6 Tank Removal

The tank atmosphere and excavation area should be regularly tested for flammable or combustible vapor concentrations until the tank is removed from both the excavation and the site. Readings should be taken at the bottom, middle, and upper portions of the tank, and the instrument should be cleared after each reading. If the tank is equipped with a non-removable fill tube, readings should be taken through another opening. Readings of 20% or less of the LEL must be obtained before a tank is considered safe for removal. When totally removing an existing underground storage system, a small amount of contaminated backfill may be encountered. The contamination can be due to minor spills and drips during previous operation of the facility or from drips and minor spills that may occur during removal.

9.7 Cleaning

Personnel employed to clean petroleum storage tanks should be adequately trained and thoroughly familiar with the safety precautions for controlling the hazards associated with tank cleaning. Procedures and processes used to clean the inside of a confined space shall be reviewed and authorized by an OSHA qualified person. The method to be prescribed shall be dependent upon the product in the space. If the confined space contains a flammable atmosphere above the upper flammable limit, it shall be purged with an inert gas to remove the flammable substance before ventilating with air. Initial cleaning shall be

done from outside the tank if at all possible. Special procedures should be adopted to handle the hazards created by the cleaning process itself. The tank vapor space is to be tested by placing the combustible gas indicator probe into the fill opening with the drop tube removed. Readings should be taken at the bottom, middle, and upper portions of the tank, and the instrument should be cleared after each reading.

If any time during the tank cleaning process, tank entry is necessary, the following entry procedures must be followed at a minimum; work involving entry into an empty petroleum tank without the use of respiratory protective equipment must meet all the following requirements:

- Oxygen content is not less than 19.5% measured by an oxygen analyzer instrument.
- Toxic vapor concentrations are within their established exposure limit values.
- Hydrocarbon vapors are below 10% of the lower flammable limit.
- The tank has been cleaned in accordance with this design.

To obtain a safe tank atmosphere, the space should be mechanically ventilated until the vapor concentration in the interior spaces near the opening to the tank has been lowered to the appropriate exposure limit value. Because some hydrocarbon vapor may be released during tank cleaning procedures, mechanical ventilation should be continued and its effectiveness verified by continuously monitoring the tank atmosphere. Only when the PEL requirement has been met and the oxygen content in the tank atmosphere is above 19.5% by volume is it safe for men to enter a tank without respiratory equipment.

Air within a tank that has been closed for an extended period, even through the tank has been previously cleaned and is empty, may become deficient in oxygen if the tank metals have rusted. If the oxygen content of the tank cannot be increased to at least 19.5% by mechanical ventilation, entry without approved air supplied respiratory protective equipment shall not be permitted. If the oxygen content is below 16%, entry must not be made.

9.8 Liquid Transferring

Personnel engaged in material transfer activities, or within 50 feet, shall initially wear Level D-Modified PPE. Air monitoring for gasoline vapors, as described in Paragraph 9: Exposure Monitoring/Air Sampling Program, of this section, shall be conducted during transfer operations. During transfer operations (e.g., pumping, pouring, siphoning, and similar liquid/sludge transfer operations) all elements of the transfer train (e.g., storage tank, pump and hose, and receiving container) shall be bonded and grounded to prevent the discharge of static electricity; plastic (PVC) piping is not to be used. The pumping operation (pump, personnel, and receiving containers) shall be located in an area which is vapor-free, upwind from the tank, and outside the probable path of vapor dispersion. Tank residues shall be collected in drums, tanks, or tank trucks labeled according to Department of Transportation (DOT) standard 49 CFR Part 171 and Part 172 and disposed of properly as specified in SECTION: UNDERGROUND STORAGE TANK REMOVAL.

9.9 Noise Monitoring

During site activities, the Contractor shall conduct noise monitoring at a representative number of site work areas, using an ANSI Type II (A Scale, slow response) dosimeter or sound level meter, to assure that operations are in compliance with the OSHA Hearing Conservation Standard (29 CFR 1910.95). Additionally, disposable hearing protection devices shall be available to site personnel upon request. If measured noise levels exceed 85 dBA, hearing protective devices with an NRR of at least 28 meeting ANSI Standard 53.19-R-1879 shall be worn by all site personnel within the affected zone.

10.0 STANDARD OPERATING SAFETY PROCEDURES, ENGINEERING CONTROLS, AND WORK PRACTICES

During all site activities, the Contractor should follow standard operating safety procedures and work practices to reduce and maintain employee exposure to unnecessary risks and/or potential contamination. The following engineering controls shall be implemented as needed:

- General ventilation systems for confined space entry, and welding and cutting operations;
- Use of work assignments that place employees upwind of sources of air contaminants; and
- Use of work schedules that ensure no employee works in the EZ alone at any time. Each worker shall have a co-worker with whom visual contact shall be maintained at all times. The buddy system protects against an employee becoming stressed without a co-worker being aware of his or her condition. It also enables co-workers to watch out for each other while in the proximity of potential chemical and physical hazards and to observe the integrity of PPE.

Cleaning of the USTs may require entry of the tanks by Contractor personnel. Confined space entry is highly dangerous and proper procedures must be followed to protect the health and safety of the workers entering the confined space. The Contractor must, as a minimum, ensure these controls are followed for confined space entry:

- Station an authorized attendant, equipped with the appropriate PPE and rescue equipment, outside the confined space;
- Equip all employees who enter confined spaces with harnesses and lifelines;
- Personnel shall not enter storage tanks without complying fully with Reference 1.2.1 (of this section), Section 27, "Work in Confined Spaces". The requirements of Section 27 include testing the atmosphere of the confined space, providing mechanical exhaust ventilation, and isolating the space from power and piping. Specified confined space entry procedures shall be addressed by the Contractor in the SSHP;

- Maintain visual, voice, or signal communication between the attendant and all employees working inside the confined space;
- Equip attendant with a means to readily summon assistance; and
- If the confined space is poorly illuminated, provide employees with suitable (e.g., intrinsically safe) portable lighting. Prohibit use of matches and open-flame lights. Guard portable lights to prevent bulb breakage. Use non-sparking tools in confined spaces that may contain flammable vapors.

10.1 Work Zone Controls

The Contractor shall establish work zone controls designed to keep contamination in the smallest possible area and to prevent contamination of equipment and property during cleanup operations. Variations in the work control program shall be with the concurrence of the CO or COR. The Contractor shall, for all zones:

- Ensure employees wear the PPE needed for the zone they are in;
- Ensure employees use designated access points for movement of personnel and equipment between zones and on and off the site;
- Post on access gates, HAZARDOUS AREA - KEEP OUT;
- Restrict access to Government authorized or Contractor certified personnel; and

10.1.1 Exclusion Zone. The Contractor shall ensure these controls are used in the Exclusion Zone (EZ):

- Set the EZ boundary so that it encompasses areas around USTs and areas where contaminated soil is present. The placement of the boundary depends on several factors such as the size of the UST, the area required for excavation equipment, the amount of soil to be removed, and the area required for removal equipment. The boundaries shall be adjusted as cleanup progresses;
- Mark the EZ boundaries as described in paragraph 10.4: Caution Signs and Labels of this section.

10.1.2 Truck Loading Zone. The Contractor shall ensure these controls are used in the Truck Loading Zone (TLZ):

- Set the TLZ boundary so that the TLZ encompasses the area where trucks are loaded;
- Permit only those trucks that are being loaded to enter the TLZ to minimize the time that truck drivers are in the TLZ.

10.1.3 Contamination Reduction Zone. The Contractor shall ensure these controls are used in the Contamination Reduction Zone (CRZ):

- Set the CRZ boundaries so the CRZ encompasses the area between the EZ and the Support Zone (SZ);
- Direct all personnel and equipment exiting the EZ and TLZ through the CRZ for decontamination. (The Contractor shall supply a decontamination trailer for personnel).

10.1.4 Support Zone. The Contractor shall ensure these controls are used in the SZ:

- Set the SZ boundaries so that the SZ covers the area outside the EZ, TLZ, and CRZ;
- Locate change and shower rooms (Decontamination trailer), toilets, lunch and break areas, and operations direction and support facilities (including supplies, equipment storage, and maintenance areas) in the SZ.
- Communications shall also be maintained between personnel in the SZ and personnel location at the disposal site. Emergency response procedures are discussed in more detail in Section 14 -- Emergency Response. Communications devices shall be wiped off with damp towels prior to being taken into the Support Zone.

10.1.5 Excavation Area. The Contractor shall ensure these controls are used in the excavation area:

- Fence or delineate the excavation area with a prominent visible barrier that warns of the hazard to project employees and the general public;
- Keep the barrier in place until the excavation is backfilled to the original elevation.
- The Contractor shall ensure safety barriers with appropriate warning signs are erected at the entrance and exit of a confined space.

10.2 Materials Handling Controls

The Contractor shall follow the rules set forth in References 1.2.1 and 1.2.3, of this section, for materials handling, storage, use, and disposal (See Paragraph 1.2 of this section). The Contractor shall ensure that:

- There are safe clearances for mechanical handling equipment in roadways, at loading areas, and wherever turns or passages are made;
- All roadways are kept in good repair and free of debris that could create a hazard;

- Permanent roadways are marked;
- Covers, guard rails, and markers are in place to protect personnel from open pits, ditches, and other hazards;
- Employees are a safe distance from heavy equipment used to remove materials and from trucks in the TLZ when soil is being dropped into the trucks;
- Dust emissions are kept to a minimum.

10.3 Caution Signs and Labels

The Contractor shall post signs and attach labels as directed below. Signs and labels shall be printed in bold large letters on contrasting backgrounds. Signs shall be visible from all points where entry might occur and at such distance from the restricted area that employees may read the signs and take necessary protective steps before entering.

Before site operations begin, the Contractor must mark the perimeter with steel posts connected with colored tape or other visual means. Post triangular warning flags or signs every 100 linear feet around the perimeter and at the entrance road or path that read, HAZARDOUS AREA - KEEP OUT and that also direct visitors to the authorized entrance.

Before UST and soil removal operations begin, the Contractor must mark the boundary with colored tape the same way as described above for the site perimeter and post warning flags or signs every 100 feet and at the entrance that read:

HAZARDOUS AREA - KEEP OUT
DANGER
AUTHORIZED PERSONNEL ONLY
PERSONAL PROTECTIVE EQUIPMENT IS REQUIRED IN THIS AREA.

In addition, the Contractor must post signs that read "NO SMOKING" at entrance to CRZs, TLZs, and EZs before operations begin, mark the break areas and post areas where smoking is permitted, and post warning signs around the entrance and exit of confined spaces.

10.4 Hot Work

Hot work is any work involving burning, welding, riveting, or similar fire producing operations, as well as work which produces a source of ignition, such as drilling, abrasive blasting, and space heating. If repairs involve hot work, surfaces to be heated should be free of liquid hydrocarbons and hidden deposits that will generate vapors. The application of heat from cutting and welding may produce flammable or toxic vapors. Frequent tests should be made, therefore, to ensure that the atmosphere in the tank is not in excess of 10 percent of the lower flammable limit and that the threshold limit value requirement is met. At 10 percent of the lower flammable limit, the hydrocarbon concentration will in almost all cases exceed the PELs of toxic materials, and appropriate personal protective equipment should be used. Flammable and toxic vapors may generate from remaining sludges or residues on the tank walls. Continued ventilation will minimize any accumulation of