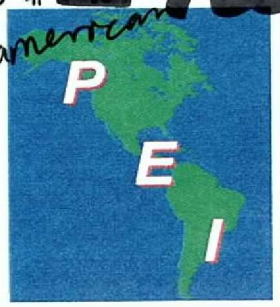

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HEALTH AND SAFETY FOR ARCHAEOLOGISTS AND CRM PROFESSIONALS

Produced Through a Grant From
The New York State Occupational Safety and Health
Training and Education Program

Contract Number: C008414

Prepared By:

PANAMERICAN ENVIRONMENTAL, INC.
and
PANAMERICAN CONSULTANTS, INC.

1999

HEALTH AND SAFETY FOR ARCHAEOLOGISTS

AND CRM PROFESSIONALS

For public and private professionals, students and faculty, museum staff, forensic scientists, staff and contract workers

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PREFACE

As archaeologists working on numerous projects throughout the country and the world, we have become aware, through years of experience and observation, that compliance with basic health and safety procedures by cultural resource management professionals is seldom a major concern. A little of the "Indiana Jones" carelessness is found in most large field projects. Many examples from the past come to mind, including conducting excavations in 40-foot deep, telephone booth-size excavation units on the Missouri River attempting to document hundreds of years occupation—without shoring the trench; hiking all over western Mexico or southern Puerto Rico carrying little water and waiting for the onslaught of heat exhaustion or sun stroke; surveying in former bombing ranges with unexploded ordinance scattered on the surface; or going into construction trenches in Buffalo without shoring the trench or assessing the potential for the presence of hazardous materials. The last concern in archaeological investigations is safety.

This ignorance has often resulted in lost time accidents or injuries from a range of hazards from poison ivy exposure to heat exhaustion. For the most part, this noncompliance is more the result of a lack of education than from negligence. In most field methods courses or field schools these issues are, in the main, inadequately addressed. Some CRM professionals have even been known to suggest that they were exempt from OSHA standards and other basic safety procedures. In 1998, Panamerican Environmental, Inc. (PEI) applied for, and was awarded, a grant from the New York State Occupational Safety and Health Training and Education Program to produce a health and safety manual that would begin to remedy this problem.

This manual was prepared from references in the public domain and contains no proprietary information. The principal author/compiler was Mr. Peter J. Gorton, MPH, of PEI. Individuals from Panamerican Consultants, Inc., PEI's affiliate, contributed to the document *pro bono*. These included Drs. Frank J. Schieppati, Michael A. Cinquino, Mr. Mark A. Steinback, Ms. Suzanne Vizzini, and Mr. Martin Lewars. The authors would also like to express their appreciation to the individuals who reviewed the draft document and provided comments. These include Dr. William Engelbrecht (State University of New York University at Buffalo), Dr. Robert Kuhn (New York State Office of Parks, Recreation and Historic Preservation), and Drs. Nina Versaggi, Albert Dekin, and B. Curtis West (State University of New York University at Binghamton). We also would like to especially thank Ms. Joan Komorowski, grant manager at the New York State Occupational Safety and Health Training and Education Program for her assistance and patience.

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1.0 INTRODUCTION—HEALTH AND SAFETY PROGRAM

1.1 PURPOSE

In 1998, Panamerican Environmental, Inc. (PEI) applied for, and was awarded, a grant from the New York State Occupational Safety and Health Training and Education Program to produce a health and safety manual for archaeologists and other cultural resources management (CRM) professionals. This manual is the result. It was prepared by PEI from references in the public domain and contains no proprietary information. Individuals from Panamerican Consultants, Inc., PEI's affiliate, contributed to the document *pro bono*.

This manual is designed to assist archaeologists and other CRM professionals to identify, outline, and evaluate techniques to control the specific health and safety hazards that may be encountered during the performance of various archaeological and cultural resources activities. The goal of this manual is three-fold: to provide the necessary information to archaeological and CRM firms, professional organizations, institutions, and agencies so they can develop a general health and safety program or a set of procedures; to facilitate project- and activity-specific health and safety planning; and to provide a resource to develop health and safety training. Underlying these objectives is the intent to increase the general awareness of the CRM community to the hazards of their work and to provide established guidelines and procedures designed to reduce or eliminate the potential for exposure to substances, agents, or activities that may cause injury or illness.

Conceived as a reference or guide for health and safety training, planning, and development, the manual is based on the requirements set forth in the Occupational Safety and Health Administration (OSHA) 29 CFR 1910 (General Industry Standards) and 29 CFR 1926 (Construction Industry Standards) (See Appendix B) as well as other federal and state standards and guidelines. This handbook has been divided to include separate topical sections to allow individuals to gain an overview of various health and safety topics or to focus on individual health and safety needs.

1.2 APPLICABILITY IN ARCHAEOLOGY

Archaeologist and other CRM professionals perform a wide variety of work activities in all environments (terrestrial and maritime) including such places as historic buildings, shipwrecks, landfills, military installations, laboratories, and hazardous waste sites that may involve exposure to physical or environmental hazards. Health and safety training and awareness is beneficial to both employers and employees for many reasons including reducing loss time accidents, injuries, or illness.

Numerous projects directed at the revitalization of our towns and cities are being undertaken throughout the country. Many of these include archaeology, cultural resources management or historic preservation as key components. Archaeology is a forgotten profession with regard to health and safety and OSHA compliance. CRM professionals

work in a plethora of arenas for both private firms and public entities, including state and federal agencies or museums as well as colleges and universities and increasingly as contract workers. Areas of expertise within the general CRM discipline include terrestrial and underwater archaeologists, architectural historians, restoration architects, cultural resources managers, museum curators, forensic and physical anthropologists, laboratory workers, field technicians, and university and college students and faculty. Activities commonly involve hand excavation of various types (e.g., shovel tests, test units, trenches, etc.), using drill rigs or backhoes to locate deeply buried deposits, excavating both terrestrial and underwater sites which may be contaminated with hazardous waste (e.g., historic period industrial chemicals) and in some instances infectious agents. Archaeologists are also at risk from diseases caused by rodents and insects as well as physical hazards. **OSHA regulations affect cultural resources projects and both firms and individuals have been cited and fined for violations.**

General health and safety requirements for CRM professionals should include the following:

- Professionals should receive health and safety indoctrination and continuing training.
- No person should be required or instructed to work in surroundings or under conditions that are unsafe or dangerous.
- Employers should develop and maintain a health and safety program that complies with OSHA regulations.
- Professionals are responsible for following applicable health and safety requirements, maintaining safe work environments, and halting work when unsafe conditions exist.
- A project specific health and safety plan should be developed as warranted or as required by regulations.

A health and safety program designed to protect these individuals should contain requirements and procedures for protection against physical, chemical, and biological hazards. The program should address accident prevention and the maintenance of safe and healthful work environments, including general health and safety policies, employee and supervisor responsibilities, training requirements, medical monitoring, hazard communications, personnel and respiratory protection, emergency planning, etc. A Safety Officer (SO) should be assigned to each project that potentially involves exposure to physical, chemical, or biological hazards. The SO should be selected based on training or demonstrated prior experience in conducting safety operations. During field operations, an SO should be assigned to oversee compliance with project-specific safety requirements. Some projects, especially those occurring in areas where the potential for soil

contamination or unexploded ordnance (UXO) exist, will require the development of a formal health and safety plan depending on the specifics of the project.

1.3 HEALTH AND SAFETY OVERVIEW—CHEMICAL, BIOLOGICAL, AND PHYSICAL

In the United States, tens of millions of dollars are spent on cultural resources management projects each year in the regulatory arena alone. Many millions more are appropriated in the private sector and academia. Unfortunately, despite the disbursing of all this money, health and safety and OSHA compliance is often overlooked. It has been speculated by some that this condition has arisen from a confluence of factors including ignorance and a reluctance to call attention to a particular project as well as a long standing attitude of complacency; the assumption that somehow digging for artifacts doesn't entail risk. Worse, some firms are reluctant to adopt safety measures that might add to a project's cost or impact a construction project.

CRM professionals are exposed to a myriad of chemical, biological, as well as physical hazards. Since a majority of archaeological workers are free-lancers who are not permanently employed and who work from project to project, the true incidence of work-related disease or injury is most likely under-reported. CRM professionals are often unaware of the many hazards and health/safety regulations associated with their profession. The hazards vary widely and include potential physical (those associated with general construction such as trenching and unstable historic period structures or heat and cold), biological (exposure to poisonous or disease-transmitting plants, animals, and insects), chemical and toxic materials and wastes (hazardous and industrial wastes, laboratory chemicals, radium and lead-containing artifacts). The following is an overview of the chemical, physical, and biological hazards to which CRM professionals are potentially exposed.

Physical Hazards

Heat/cold stress
Noise/vibration
Excavations
Sun
Construction hazards
Traffic exposures
Overhead loads
Mobile equipment
Diving hazards
(Underwater archaeology)
Unsafe Buildings or structures,
Electrical
Slips, trips, falls

Biological Hazards

Airborne fungi
Mosquito-borne diseases
Tick-borne diseases
Other
- Hantavirus
- Rabies
- Tetanus
- Poison Ivy/Sumac
- Poisonous snakes

Chemical Hazards

Toxic chemicals
Hazardous waste
- air
- soil
- water

Asbestos
Lead
Pesticides
Lab hazards
Curation/Forensic
Radiological

1.4 ACTIVITY HAZARD ANALYSIS/HAZARD IDENTIFICATION

The types of field activities associated with these projects range from simple walkovers of an area to hand excavations to excavations using heavy equipment; from surveys within and near coastal regions to surveys of buildings and structures; from museum curation to forensic investigations. Each CRM activity will have specific, associated hazards. Some of the more common activities are summarized below.

CULTURAL RESOURCES/ARCHAEOLOGICAL ACTIVITY/HAZARD SUMMARY

Shovel testing/Hand screening - This activity commonly involves the use of shovels, trowels, tape measures, screens (e.g., ¼" mesh), machetes, pick axes, as well as the use of insect repellent and toxic plant protection. This activity is most often conducted in open fields, thick brush, wooded areas, and may require CRM professionals to traverse steep locales or water (streams, rivers, standing water), work around construction sites, or in industrial/commercial areas.

Hazards can include: Exposure to hazardous or industrial wastes, chemicals, physical hazards and ergonomic concerns, biological exposure to insects, snakes, sun, cold, vegetation and poisonous plants.

Excavation of Units and small trenches - This activity is most often associated with excavations typically measuring 1 x 1 meter, 1 x 2 meter, 2 x 2 meter and ~1 meter in depth. The work involves use of shovel, trowel, metal tape measure, hand screening (¼" mesh), chaining pins, utility knife/razor, hammer, wooden stakes, nylon string, machete, pick axe and sometimes heavy equipment such as bulldozer or backhoe. Sometimes specialized instruments such as a proton magnetometer are used. Activities are conducted in a variety of physical settings, such as open fields, thick brush or wooded areas, construction sites, industrial/commercial areas, coastal areas, and heavy traffic zones in urban areas.

Hazards can include: Exposure to hazardous or industrial wastes, chemicals, physical hazards and ergonomic concerns, biological exposure to insects, snakes, sun, cold, vegetation and poisonous plants.

Trenching (Large) - The typical trench excavated for cultural resources investigations can range from 1 to 2 meters wide and from 2 to 10 meters long, with a depth of 1 to 3 meters, however, many can become much wider and deeper. Work associated with trenching activities can involve the use of a drill rig, backhoe, ladder, shoring, shovel, trowel, tape measure, hand screening (¼" mesh), chaining pins, utility knife/razor, hammer, wooden stakes, dewatering pump, etc. Like other the activities, trenching can be conducted in a variety of environmental settings including open fields, thick brush, wooded areas, construction sites, industrial/commercial areas, coastal areas, and heavy traffic zones. This is one of the more unsafe activities that is routinely undertaken by CRM professionals.

Hazards can include: Exposure to hazardous or industrial wastes, chemicals, physical hazards and ergonomic concerns, biological exposure to insects, snakes, sun, cold, vegetation and poisonous plants.

Mechanical Stripping - The common minimum size of excavations associated with this activity is 3+ meters x 3+ meters and 0.5 meter in depth. The equipment used is similar to "Trenches" however, stripping is typically broad and shallow rather than deep. The mechanical work is often followed by hand excavation or "clean-up work."

Surface Inspection - Usually performed in open settings, such as agricultural fields, this activity increasingly is being conducted in urban environments.

Hazards can include: Potential exposure to pesticides, herbicides and fertilizers. Plowed walking surfaces are often uneven, and urban environments present additional safety hazards such as traffic, exposure to insects, snakes, sun, cold, and vegetation.

Maritime Archaeology - Involves shallow and deep underwater investigations in coastal regions, lakes, and rivers. Typical equipment includes buoyancy compensators, regulators, air tanks (scuba), wet and dry suits, diving weights and belts, mask, snorkel, fins, boat, knife, electronic gear (e.g. sonar), etc.

Hazards can include: Dive safety, chemical, physical, ergonomic, and biological hazards.

Artifact Curation - Artifact curation can include the use of various types of equipment such as plastic bags, marking pens, small brushes, "dental" picks, ultraviolet lighting (long and short wave) for lead detection in glass and ceramic, magnifying lens, scale, micrometer, caliper, glaze, acetone (bone preservation).

Hazards can include: Exposure to dusts, biological agents (bacteria), and chemicals (ferric/corroded metal, dirt, bone), as well as physical hazards such as exposure to ionizing radiation.

Historic Preservation/Architectural Assessments - Activities associated with historic preservation typically include projects to improve, protect, preserve, rehabilitate, or restore properties subject to the State and/or National Registers. These projects can involve first time assessments of structures, exterior restorations, interior restoration, revitalization of urban areas, or those which enhance or restore maritime heritage.

Hazards can include: Physical hazards associated with structurally unsound buildings and structures, traffic, confined space, exposure to hazardous chemicals such as asbestos, PCBs, etc.

Miscellaneous: Corridor surveys for utilities or pipelines which often follow existing roads and power lines.

Hazards can include those associated with shovel testing and surface inspection.

2.0 PHYSICAL HAZARD PROGRAM FOR ARCHAEOLOGISTS

2.1 HEAT/COLD STRESS MANAGEMENT

CRM professionals can be exposed to heat/cold stress in a variety of situations specific to their occupation. Heat stress is one of the more common and dangerous hazards associated with cultural resources investigations and one that should be taken very seriously and requires proper planning and education. Unlike exposure to low levels or chronic exposure to chemicals, heat stress poses a potential, immediate health hazard and has potentially severe consequences. Some examples of tasks or situations that may be associated with or may cause heat/cold stress includes all open area work and, in particular, that which involves hand excavation.

HEAT STRESS

Heat stress can contribute significantly to accidents and is one of the most common and potentially serious illnesses at work sites. For field workers, heat stress usually occurs any time work is performed at elevated temperatures and particularly as a result of protective clothing decreasing natural body ventilation. Because of the risk, regular monitoring and preventive measures may be necessary should conditions warrant. Preventive measures may include additional rest periods, supplemental fluids, restricted consumption of drinks containing caffeine or alcohol, use of cooling vests, or modification of work practices. Work modification techniques may be necessary during ambient temperatures of greater than 29°C (85°F) while wearing normal clothing or exceeding 21 °C (70 °F) while wearing personal protective clothing.

Typically, work conducted during cultural resources and archaeological investigations consists of light manual labor and visual observation. However, some tasks may involve heavy manual labor or repeated efforts in hot conditions. In addition, increased risk will exist when resource activities are being performed at hazardous waste sites or old industrial areas where protective clothing is required. CRM professionals engaged in activities with potential exposure to excessive ambient temperatures and humidity should be aware of the dangers associated with "heat stress." Should heat stress hazards and risk factors occur, the information and procedures outlined below will apply.

CRM professionals should establish a Heat Stress Management Program which outlines responsibilities and basic requirements for personnel who may be required to work in situations where the ambient temperature exceeds 21°C (70°F) while wearing protective equipment (e.g., hazardous waste site investigations) or when the ambient temperature exceeds 29°C (85°F) while wearing normal clothing. Because heart stress is one of the most common and potentially serious illnesses at job sites (particularly when protective clothing is worn), regular monitoring and other preventive measures are warranted.

Although there are no regulations addressing heat stress, OSHA recognizes heat stress as a potentially serious health hazard and can cite employers under the "general duty clause" of the Occupational Safety Health Act, if heat-related illness is occurring or likely to occur.

Heat Stress Hazards and Risk Factors

Field workers should learn to recognize the various forms of heat stress. A person's exposure to increased ambient temperatures and humidity produces physiological responses referred to as heat stress which are characterized by an increase in the: a) core or deep body temperature; b) heart rate; c) blood flow to the skin; and d) water and salt loss due to sweating. If the body's normal physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur. Conditions of excessive heat stress may occur either when the physical work is too heavy or the environment is too hot relative to the work being performed. If work is performed under hot environmental conditions, the work load effort must be reviewed and the heat exposure limit maintained at or below the level to protect the worker from the risk of acute heat illness.

In general, there are four types of physiological disorders associated with heat stress. They include:

Heat Rash is caused by continuous exposure to heat and humid air and aggravated by chafing clothes. The condition can decrease the body's ability to tolerate heat. Symptoms include a mild skin rash occurring as a result of obstructed sweat glands, often associated with impermeable clothing.

Heat Cramps are usually a result of excessive perspiration that is not balanced by adequate fluid intake and may be the first sign of a more serious heat stress condition. Symptoms typically include painful muscle spasms in the extremities and abdomen due to the inadequate balance of normal electrolytes lost from sweating.

Heat Exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids. Symptoms include pale, clammy, moist skin, profuse perspiration, extreme weakness, dizziness, nausea, rapid pulse, and a small increase in body temperature. A person with heat exhaustion may complain of a headache, vomit, and show obvious signs of dizziness. Personnel with heat stress should be moved to a cool, air conditioned place, clothing should be loosened, their head placed in a low position, and provided with bed rest. The individual should drink 1 to 2 cups of water immediately, and every 20 minutes thereafter until symptoms subside.

Heatstroke is a serious medical condition that calls for emergency medical action. Heatstroke is an acute and dangerous, potentially fatal disorder resulting from failure of the body's thermoregulatory system—the individual's temperature control system that includes sweating. The classical description of heatstroke includes (1) a major disruption of central nervous function (unconsciousness or convulsions); (2) a lack of

sweating; (3) hot, dry, red or mottled skin; and (4) a core temperature in excess of 41°C (105.8°F). Treatment includes cooling the victim quickly. If the body temperature *is not* reduced quickly, permanent brain damage or death will occur.

Certain factors play significant roles in the development of, or predisposition to, heat stress disorders including:

- Acclimatization which leads to increased and quicker sweating, cooler skin due to an increase in evaporative cooling, and a lower, more stable core body temperature.
- Age, in that older individuals may be more susceptible.
- Gender, although women perform similarly or only slightly less well than men under hot circumstances.
- Body Fat, in that decreased cardiovascular capacity frequently associated with obesity predisposes individuals to heat disorders.
- Water and electrolyte balance requires the replacement of body water and electrolytes lost through sweating. If this water is not replaced by drinking, continued sweating will draw on water reserves from both tissues and body cells leading to dehydration.
- Use of alcohol and certain medications reduces heat tolerance and increases the risk of heat illness. Many drugs, including diuretics and antihypertensives, can interfere with the body's thermoregulation.
- Physical fitness and physical conditioning enhances heat tolerance by increasing the functional capacity of the cardiovascular system, and reduces the time required to develop heat acclimatization.

The factors listed above should be taken into account by all CRM professionals when planning or executing CRM projects in hot weather or hot environments.

HEAT AND STRESS PREVENTION

Preventive measures should be taken to prevent personnel from experiencing heat stress illness. Preventive measures include: favorable work scheduling, acclimatization of workers to hot environments, drinking sufficient quantities of fluids, providing cool, sheltered work and rest areas, and utilizing cooling devices as appropriate of feasible.

Under hot conditions where sweat production may reach 6 to 8 liters per day, voluntary replacement of the water lost is usually incomplete. Every effort should be made to encourage individuals to drink water, low-sodium noncarbonated beverages or electrolyte

replacement fluids (e.g., Gatorade). Drinking fluids 24 hours in advance (fluid loading) is recommended. Salt tablets as dietary supplements are not generally recommended.

Workers should drink at least 500 ml (one pint) of water ½- to 1-hour before beginning work. If possible, small quantities of fluids should be consumed at periodic, frequent intervals (every 20 minutes). Individuals vary, but water intake should total 4 to 8 liters (quarts) per day. When heat stress is considered a potential problem, a minimum of 1 liter/hour/person of water should be available at the work site. Individual paper or plastic cups should be provided in order to prevent the spread of communicable disease.

Alcohol and diuretics such as caffeine (contained in coffee, tea, and many soft drinks) can increase dehydration and consumption of these beverages should be avoided during and immediately after working hours.

Exposure to direct sunlight significantly increases the overall thermal loading of the body, thereby increasing an individual's susceptibility to heat stress illnesses. Whenever possible, work should be conducted under suspended tarps, in shady areas or in other sheltered areas in order to reduce thermal loading caused by the sun. Cool, sheltered areas should be provided for rest breaks.

Workers wearing protective garments at hazardous waste sites can be kept cool by using auxiliary cooling devices such as those that direct high velocity air inside the protective clothing. Cultural resources projects requiring sophisticated cooling devices should select the most appropriate cooling device at the time of safety plan development.

HEAT STRESS MONITORING

Heat stress monitoring should be considered when ambient temperatures exceed 70°F especially if protective clothing is being used. Monitoring includes:

- **Heart Rate Monitoring** - An increase in the heart rate (HR) is a significant indication of stress, whether induced by exposure to heat or through physical labor. Although baseline heart rates can vary significantly between individuals and during the day for any specific individual, an HR of 110 beats per minute or greater is an indication of physiological stress. HR should be measured by radial (wrist) or carotid (neck) pulse for 30 seconds as early as possible in the rest period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 33 percent while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute at the beginning of the next rest period, the following work period should be further shortened by 33 percent while the length of the rest period stays the same. The procedure should be continued until the rate is maintained below 110 beats/minute.

- **Body Temperature Measurements** - body temperature should be measured orally with a clinical thermometer as early as possible in the rest period. Oral temperatures

(OT) at the beginning of the rest period should not exceed 99.6 degrees F. If it does, the next work period should be reduced by 33 percent, while the rest period remains the same. This procedure is continued until the body temperature is maintained below 99.6°F.

- **Managed Work/Rest Schedule** - CRM professionals working in hot environments should be cognizant of heat stress potentials and should develop an appropriate work/rest regime. Work at hazardous waste sites in protective clothing will require alternate work/rest schedules which should be designed by safety professionals and incorporated into the site safety plan.

COLD STRESS

Persons working outdoors in low temperatures, especially at or below freezing (32°F or 0°C) are subject to cold stress. Exposure to extreme cold can cause severe injury to the body. Areas of the body that have high surface area-to-volume ratio, such as fingers, toes, and ears, are most susceptible. The following summary of the signs and symptoms of cold stress are provided as a guide for field and safety personnel.

Incipient frostbite is a mild form of cold stress characterized by sudden blanching or whitening of the skin.

Chilblainis an inflammation of the hands and feet caused by exposure to cold moisture. It is characterized by a recurrent localized itching, swelling, and painful inflammation of the fingers, toes, or ears. Such a sequence produces severe spasms, accompanied by pain.

Second-degree frostbite is manifested by skin with a white, waxy appearance and the skin is firm to the touch. Individuals with this condition are generally not aware of its seriousness because the underlying nerves are frozen and unable to transmit signals to warn the body. Immediate first aid and medical treatment are required.

Third-degree frostbite will appear as blue blotchy skin. The tissue is cold, pale, and solid. Immediate medical attention is required.

Hypothermia develops when body temperature falls below a critical level. In extreme cases, cardiac failure and death may occur. Immediate medical attention is warranted when the following symptoms are observed:

- Involuntary shivering
- Irrational behavior
- Slurred speech
- Sluggishness

Wet clothing combined with cold temperatures can lead to hypothermia.

To administer first aid for frostbite: Take the victim indoors and warm the areas *quickly* in water that is between 39°C and 41°C (102°F and 105°F). Give person a warm drink—**not** coffee, tea or alcohol—*and the victim must not* smoke. Keep the frozen parts in warm water or covered with warm clothes for 30 minutes, even though the tissue will be very painful as it thaws. Then elevate the injured area and protect it from injury. Do not allow blisters to be broken. Use sterile, soft, dry material to cover the injured areas. Keep victim warm and **get immediate medical care.**

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

Note:

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

2.2 TRENCHING AND EXCAVATION

Many tasks performed by CRM professionals involve some form of trenching operation. These include trenches used to determine the spatial extent of a site or subsurface feature, to expose underground structures, or for cross-sectioning a feature such as a midden or other large element.

There are a variety of potential health and safety hazards associated with excavations. These include:

- Loose rocks and soil at the excavation face.
- Hazardous atmospheres, such as oxygen deficiency, flammable gases or vapors, and toxic gases.
- Structures, fencing, stored materials, or other materials, which may interfere with safe excavations.
- Below and aboveground utilities (such as water and sewer lines, gas, power, telephone, and optical cable lines, etc.).
- Overhead power lines and other utilities that may be contacted by the excavation equipment.
- Vehicle and heavy equipment traffic around the excavations.
- Falling loads from lifting or digging equipment.
- Water accumulation within excavations.

OSHA requirements for trenching and excavations are contained in 29 CFR, subpart P, 1926:650 thru 1926.652. The following practices should be incorporated into cultural resources projects.

- Basic minimum excavation requirements should include:

  - Personnel entry into excavations should be minimized. Inspections or artifact removal should be done from above the excavation, whenever possible.

  - A project-specific excavation plan should be developed for all projects where trenching or excavations are planned.

  - Personal protective equipment including hard hat, safety glasses, and steel-toe work boots may be required.

  - Sloping, shoring or some other equivalent means should be utilized, as required

- Surface encumbrances, such as structures, fencing, piping, stored material etc., which may interfere with safe excavations should be avoided, removed or adequately supported prior to the start of excavations. Support systems should be inspected daily.

- Underground utility locations should be checked and determined and permits as necessary should be in place prior to initiating excavations. Local utility companies should be contacted at least two days in advance, advised of proposed work, and requested to locate underground installations. When excavations approach the estimated location of utilities, the exact location should be determined by careful probing or hand digging and when it is uncovered, proper supports should be provided.

- A minimum safe distance of 15 to 25 feet should be maintained when working around overhead high-voltage lines or the line should be de-energized following appropriate lock-out and tag-out procedures by qualified utility personnel.

- Excavations five feet or more deep will require an adequate means of exit, such as a ladder, ramp, or steps and located so as to require no more than 25 feet of lateral travel. Under no circumstances should personnel be raised using heavy equipment.

- Personnel working around heavy equipment, or who may be exposed to public vehicular traffic should wear a traffic warning vest. At night, florescent or other reflective material is recommended to be worn.

- Excavation work on or adjacent to highways or streets requires signs, signals, and barricades that conform to the requirements of the current American National Standards Institute (ANSI) D6.1, *Manual on Uniform Traffic Control*

Devices for Streets and Highways. Signs, signals, and barricades should be adequately lighted at night. Flagmen should be provided when signs, signals, and barricades do not provide adequate protection.

- Heavy equipment or other vehicles operating next to or approaching the edge of an excavation will require that the operator have a clear view of the edge of the excavation, or that warning systems such as barricades, hand or mechanical signals, or stop logs be used. If possible the surface grade should slope away from the excavation.

- Personnel should be safely located in and around the trench and should not work underneath loads handled by lifting or digging equipment.

- Hazardous atmospheres, such as oxygen deficiency (atmospheres containing less than 19.5% oxygen), flammable gases or vapors (airborne concentrations greater than 20% of the lower explosive limit), and toxic gases or vapors (airborne concentrations above the OSHA Permissible Exposure Limit or other exposure limits) may occur in excavations, especially around farms, landfills, and hazardous waste sites. Monitoring should be conducted for hazardous atmospheres prior to entry and at regular intervals. Ventilation or respiratory protection may be provided to prevent personnel exposures to oxygen deficient or toxic atmospheres. Periodic retesting (at least each shift) of the excavation will be conducted to verify that the atmosphere is acceptable. A log or field book records should be maintained.

- CRM personnel should not work in excavations that have accumulated water or where water is accumulating unless adequate precautions have been taken. These precautions can include special support or shield systems, water removal systems such as pumps, or safety harnesses and lifelines. Groundwater entering the excavation should be properly directed away and down gradient from the excavation.

- Safety harnesses and lifelines should be worn by personnel entering excavations that qualify as confined spaces (refer to Section 2.3)

- Diversion ditches or dikes should be used to prevent surface water from entering the excavation and to provide adequate drainage of the area around the excavation.

- Excavations near structures should include determinations by a registered Professional Engineer that the structure will not be affected by the excavation activity or that the excavation work will not pose a hazard to personnel. Support systems, such as shoring, bracing, or underpinning, should be provided to maintain the stability of adjoining buildings, walls, sidewalks, or other structures endangered by the excavation operations.

- Loose rock, excavated or other material, and spoil should be effectively stored and retained at least 2 feet—but preferably 5 feet or more—from the edge of the excavation. Barriers or other effective retaining devices may be used in order to prevent spoil or other materials from falling into the excavation.

- Walkways or bridges with standard guardrails that meet OSHA specifications will be provided where employees, the public, or equipment are required to cross over excavations.

- Adequate barrier physical protection should be provided and excavations should be barricaded or covered when not in use or left unattended. Excavations should be backfilled as soon as possible when completed.

- Safety personnel should conduct inspections prior to the start of work and as needed throughout the work shift as well as after occurrences that increase the hazard of collapse (i.e., heavy rain, vibration from heavy equipment, freezing and thawing, etc.).

- Personnel working in excavations should be protected from cave-ins by sloping and/or benching of excavation walls, a shoring system or some other equivalent means in accordance with OSHA regulations. Soil type is important in the determination of the angle of repose for sloping and benching, and the design of shoring systems.

- One of the following options for sloping and benching systems described in section 1926.652(b) of the OSHA Excavation Standard should be used in excavations 5 feet or deeper or at the discretion of the safety personnel (refer to Figure 1 trench diagram):

  - The walls of the excavation will be sloped at an angle not steeper than 1-½ horizontal to 1 vertical. Sloping configurations will follow the slopes shown for Type C soils in Appendix B of the OSHA Excavation Standard.

  - Maximum allowable slopes and sloping and benching configurations will be determined according to soil type as described in Appendices A and B of the OSHA Excavation Standard.

  - A registered Professional Engineer should develop trench sloping and benching configurations

- Personnel should not work on the faces of sloped or benched excavations above other workers unless the workers at the lower levels are protected from falling material or equipment.

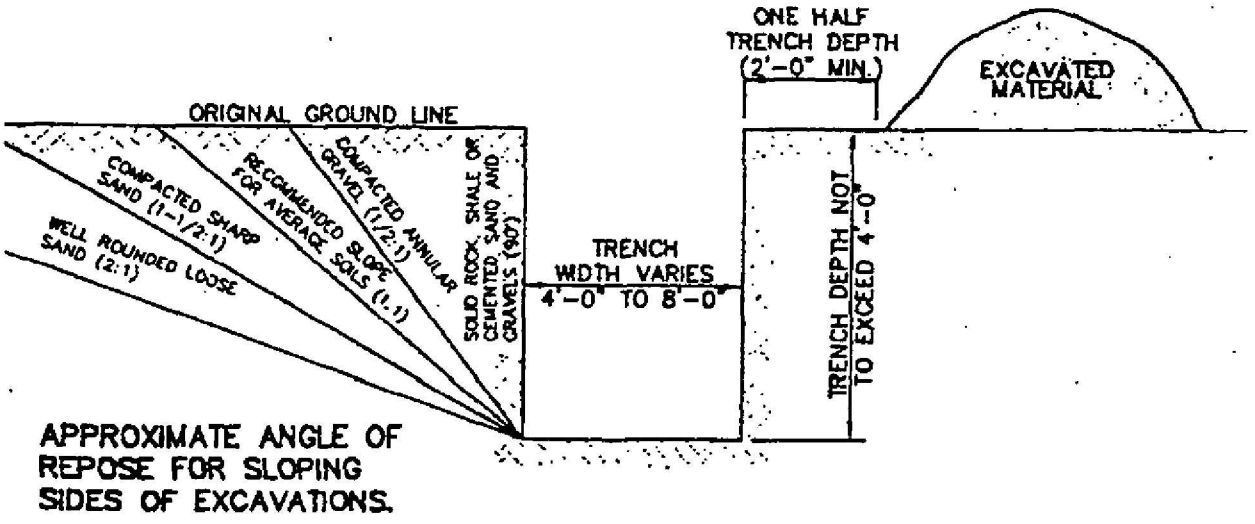


Figure 1 - Angles of repose for trenching.

- Support systems, shield systems, and other protective devices options described in OSHA (1926.652 (c)) should be followed. Cross braces or trench jacks, uprights, and walls should be secured together to prevent sliding, falling or kickouts. Additional precautions by way of shoring and bracing should be taken to prevent slides or cave-ins when excavations or trenches are made in locations adjacent to backfilled excavations, or where excavations are subjected to vibrations from railroad or highway traffic, the operation of machinery, or any other source.

Portable trench boxes or sliding trench shields are often used by CRM professionals for protection of personnel in lieu of a shoring system or sloping. Where such trench boxes or shields are used, they should be designed, constructed and maintained in a manner which will provide protection equal to or greater than the sheeting or shoring required for the trench. Shields will be installed so as to restrict lateral or other hazardous movement. Personnel are not allowed inside shields when they are being moved.

2.3 CONFINED SPACE ENTRY

Confined space work presents unique hazards to CRM professionals and requires proper preparation and attention to detail to avoid the occurrence of serious or fatal accidents. The following presents an overview of the important criteria associated with confined space entry. CRM professionals who work on projects requiring confined space entry should receive specialized training or secure the services of a trained safety professional to plan and monitor confined space entry tasks.

Prior to entry into a confined space, employers are required to evaluate the workplace to determine if there are any potential or actual hazards. Based on the hazards present, each

space will be categorized as a permit-required or a non-permit-required confined space. A permit-required confined space has one or more of the following characteristics:

- A potential to contain a hazardous atmosphere:
- Material that can cause the engulfment of an employee;
- An internal configuration that may cause an employee to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller section; or
- Contains any other recognized serious health or safety hazard

A non-permit-required confined space is one that does not contain any hazard capable of causing death or physical harm, and has no atmospheric or potential for an atmospheric hazard. These conditions must be verified by the employer.

Regulations pertaining to permit-required confined spaces are found in 29 CFR 1910.146. The OSHA standard for confined space is intended to protect workers from toxic, explosive, or asphyxiating atmospheres and from engulfment materials such as liquids or soils. The OSHA standard focuses on areas with immediate health and safety risks, denoting these as permit-required confined spaces which prevents unauthorized entry into those confined spaces.

Confined space refers to a space which, by design, has limited openings for entry and exit, which has unfavorable natural ventilation, which could contain or produce dangerous air contaminants, and which is not intended for continuous occupancy. Some examples of confined space entry associated with cultural resources investigations include entry into excavations and pits, caves, silos, vats, wells, basements or cellars, sewers or tunnels, utility vaults, and compartment of ships.

A confined space is further defined as space with the following characteristics.

1) The space is large enough and configured such that a CRM professional can bodily enter and perform work.

2) The space has limited or restricted access for entry and exit. A common attribute of confined spaces is that retrieval of a suddenly disabled worker presents a challenge.

3) The space is not designed for continuous human occupancy. Most confined spaces are designed to enclose or hold materials, processes, etc.

4) The space may be hazardous or become hazardous due to one or more of the following conditions:

    - Contain or may contain a hazardous atmosphere;

- Contains a material which could engulf a person inside a space;
- Is configured internally such that an entrant could be trapped or asphyxiated inside the space;
- Contains or may contain any other recognized serious safety or health hazard.

The types of hazards associated with confined spaces include:

- toxic, oxygen-deficient or oxygen-enriched atmospheres
- explosive or flammable atmosphere
- combustible dust atmosphere
- impaired communications
- engulfment hazards
- entrapment hazards
- mechanical and moving parts or machinery
- noise
- energized electrical equipment and electrical hazards
- falling objects
- unstable material
- cave-in or collapse
- physical limitations
- trips, slips, falls, head and eye hazards
- thermal effects such as heat\cold stress

All types of confined space entry must be well planned. Injuries occur because workers are unaware of the hazards or they neglect to follow established safety rules out of expediency, foolishness, or negligence. Ignorance and negligence have led to deaths by asphyxiation, by fire and explosion, by trauma, and by fatal exposure to toxic materials. A written program should be developed by CRM organizations to prevent unauthorized entry, to identify and evaluate confined space hazards, and to establish procedures and practices for safe entry, including testing and monitoring. Confined space entry work should be conducted by individuals experienced in confined space entry operations.

Because of the variety of hazardous conditions that may be encountered in confined space entry work, it is important that the potential hazards of the space be throughly evaluated so that adequate measures can be taken to allow safe work conditions. CRM professionals should develop an awareness of confined space situations and develop standard procedures for work in these environments.

Confined space planning and entry may include one or more of the following steps:

- Review/complete permit and checklist requirements
- Determine personnel medical surveillance and monitoring needs

- Preparation activities including assembling auxiliary or special equipment, isolate or lockout/tagout equipment.
- Develop/plan site-specific entry procedures including rescue and communication protocols and equipment.
- Atmospheric testing and safety survey (without entering) the confined space to ascertain whether toxic, flammable, or hazardous conditions exist.
- Drain, flush, or purge all original contents from the space
- Blind flange, double block and bleed, de-energize, and lock-out all sources of material, energy, or motion that are associated with the confined space.
- Ventilate and provide air circulation to the space to eliminate toxic or flammable atmospheres to include 5 to 6 complete air changes per hour.
- Control or remove ignition sources such as sparks, open flame, welding, equipment.
- Record keeping activities.

Confined spaces should never be entered to attempt rescue of fellow employees without proper planning, equipment, and training.

2.4 HEARING CONSERVATION

CRM professionals exposed to excessive noise levels can experience permanent hearing loss and other health effects. OSHA hearing conservation standards for CRM professionals are found in 29 CFR 1910.95 which include an 8-hour, time-weighted average (TWA) Permissible Exposure Limit (PEL) sound level of 90 decibels (dB). In addition, OSHA also recommends an action level of 85 dB and requires workers to be involved in a monitoring program when exposures average above this level. CRM professionals should never be exposed to impulsive or impact noise in excess of 140 dB.

High noise levels associated with CRM activities may be generated by activities such as drilling, heavy equipment operation (e.g., backhoes), and the use of impact tools such as jackhammers.

When personnel are subjected to noise levels exceeding the limits presented in the following table, feasible engineering or administrative controls should be used and if these are not effective/feasible then protective equipment will be necessary. The combined effect of noise exposure at different levels throughout the day should be considered.

CRM professionals working in prolonged situations where the average exposure to noise is at or above the current OSHA PEL (90 dB) will require engineering (equipment changes or muffling) or administrative (reduced time, shift changes) controls to reduce the noise level. If engineering or administrative controls are not feasible, then OSHA/NIOSH (National Institute for Occupational Safety and Health)-approved hearing protection will be used which provide an acoustical barrier and a reduction in the amount of harmful noise.

DURATION/DAY (HOURS)	NOISE LEVEL (dB)
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼	115

Use of hearing devices requires training in the proper selection, use, and maintenance of hearing protectors. Training should be directed at educating CRM professionals to the following:

- identification of excessive noise levels
- effects on hearing
- hearing protection devices including proper care and use
- medical monitoring (audiometric testing).

Audiometric testing should be considered for all employees who are exposed regularly to noise levels above the OSHA standards. This includes baseline testing and annual examinations at a reputable medical facility.

2.5 DRILLING AND SUBSURFACE INVESTIGATIONS

Cultural resources activities sometimes involve deep subsurface investigations using drilling equipment. While not as common as shovel tests or trench excavations, drilling equipment typically includes either the use of hand equipment, such as hand augers, powered hand augers, other hand or powered hand tools, or heavy equipment, such as drill rigs, direct push technology or backhoes. Deep subsurface assessments are usually associated with projects that require the investigation of subsurface soil conditions, depth to bedrock and water. Only properly trained and experienced personnel should operate powered equipment, especially drill rig equipment. Drilling and trenching activities are one of the most dangerous and often the most complex types of activities conducted at cultural resources projects. Most, if not all, drilling activities and heavy equipment operations are subcontracted to drilling firms which maintain individuals who possess the proper training

and experience. Activities conducted by CRM professionals in and around drill rigs and heavy equipment require proper knowledge and planning.

The most common threats associated with drilling operations include overhead and underground hazards associated with utilities, tanks, contaminant plumes and structures. Also the physical hazards associated with the drill rig operation and equipment, and uneven terrain are very real. One of the most dangerous aspects of drilling operations involves the cathead, cathead rope and mast area; only experienced and trained drillers should operate this equipment. CRM personnel should remain clear of these areas of the drill rig.

The following summarizes safe work practices to be followed by CRM professionals who work in the vicinity of drill rigs and other heavy equipment.

- Safe work practices should be enforced for drilling and maintenance activities.
- Equipment and personal protective equipment should be properly used when required. Hard hats, steel-toe safety shoes, safety glasses, and hearing protection should be basic equipment.
- Tools and equipment should be properly maintained.
- Unqualified individuals should never operate a drill rig or other heavy equipment.
- Pre-project and possibly daily safety meetings should be held to discuss safety requirements and safe operating practices on and around the rig including any project-specific drilling procedure. It is important for CRM workers to discuss and review tasks with drilling personnel so that safe distances can be enforced and specific movements discussed. This type of communication is also important with backhoe operations and other heavy equipment. Due to the noise factor associated with heavy equipment operation, hand signals for communication purposes should be reviewed.
- Conduct daily inspections of equipment by qualified personnel.
- Test use and operation of safety equipment, such as cut-off/shut down switches and fire extinguishers, and back-up alarms.
- A properly equipped first aid kit and working fire extinguisher should be available on each rig and other pieces of heavy equipment.
- Maintain current first aid/CPR training.
- Prevent non-project personnel from entering the immediate drilling or work (test pit) location and maintain observers at a safe distance.
- Maintain a list of emergency numbers and route to the nearest hospital.
- Chemicals and gasoline should be properly stored and containers labeled. Gasoline, volatile, or flammable liquids should not be used on or around a drill rig or other equipment.
- Tools should be used for their intended purpose and operational instructions should be read and followed. Pre-training and practice should be provided.

- Prior to drilling, or working with other heavy equipment, adequate site clearing and leveling should be performed to accommodate safe operations.
- Utility clearances for both above and below ground areas must be performed to insure they are cleared or de-energized. Utilities include electrical power, gas, petroleum, telephone, sewer, and water lines. Signed utility clearance from a utility locating service or client representative/superintendent should be required.
- Drilling operations should be halted during an electrical storm.

2.6 CONSTRUCTION SAFETY

A large majority of cultural resources projects are associated with construction projects and construction sites. CRM surveys and investigations can be performed prior to construction activities, during construction, after or during all phases of a construction project. The basic rule for CRM professionals working at construction sites or performing standard construction activities is that all OSHA rules that apply to construction personnel (29 CFR Part 1926 - Safety and Health Regulations for Construction) apply to CRM personnel (See Appendix B).

Although archaeological investigations are often associated with development and construction projects, they are not directly tied to construction activities. As a result, these CRM activities are frequently conducted outside the purview of OSHA. As such, OSHA General Industry Standards contained in 29 CFR 1910 also apply to cultural resource activities conducted at construction projects (See Appendix B).

Trench accidents represent one of the leading causes of injury and death at construction sites. Archaeologists regularly using trenching operations may be unaware that the unique activities they perform while in these trenches, which are specific to the profession, place them at increased risk for injury. This risk is exacerbated by the fact that often no prior training has been given the trench worker and no safety professionals are assigned to monitor the work.

The serious nature of common construction job site hazards and the relative high frequency and severity of worker injuries should dictate proper accident prevention planning. Other than excavation hazards, the hazards listed below may impact CRM professionals, and proper planning in accordance with OSHA is recommended.

- Fall protection
- Renovation and demolition safety (i.e., an engineering survey should be conducted prior to activities to avoid unanticipated collapse during demolition)
- Electrical and utility contact
- Lead and asbestos exposure
- Work-zone traffic control devices

- Back/lifting safety
- Accident reporting

Training requirements are covered in Section 11.0

2.7 TRAFFIC AND MOTOR VEHICLE SAFETY

Traffic and motor vehicle safety refers to two distinct areas: safety and safety associated with working near or alongside motor vehicles. Traffic safety is especially important at CRM investigations conducted in urban environments or along busy streets or highways. According to OSHA reporting, the most dangerous work place activity in this decade has been on the highway traveling to and from project area locations. Every safety plan should address this travel issue, especially in light of common industry practice of overloading old and unsafe vehicles with too many people and too much unsecured equipment.

The following motor vehicle safety procedures are to be followed by all field personnel.

- Assigned drivers of company vehicles must have a valid driver's license and should have received instruction in the safe operation of multi-passenger vehicles (including safety checking of the vehicle prior to operation).
- Personnel shall not mount or dismount moving vehicles.
- Personnel will not ride in the bed of any vehicle.
- Seatbelt use is mandatory.
- Drinking water is recommended to be carried on all vehicles in amounts of at least 1 gallon per person per day.
- Equipment that should be carried on all vehicles includes a fire extinguisher, a first aid kit, flares, and a shovel.
- Frequent checks of the gasoline, oil, and water temperature gauges of the vehicle.
- Tires must be kept at normal inflation pressure to avoid blowouts.
- Stay with the vehicle if it beaks down and wait for help to arrive. Do not attempt to walk to get help.

Workers will observe all pedestrian and vehicle rules and regulations. Extra caution will be observed while driving in reverse to ensure safety.

2.8 UNDERWATER/DIVE SAFETY

Underwater or maritime archaeology includes some activities associated with terrestrial investigations described above as well as activities unique to the water environment, including remote sensing surveys, underwater evaluation and mitigation of submerged resources, and geophysical data surveys. The following general and specific safety measures should be followed during maritime surveys:

- Underwater surveys should not be conducted if the work can be performed using other means, such as remote sensing equipment and techniques.
- Each dive team member should have documented training and/or experience.
- All underwater activities must be conducted in accordance with an approved dive plan and industry-specific safe operating procedures and safe practices manual.
- A project-specific dive operations plan should be developed and include safety procedures and checklists, assignments and responsibilities, equipment certification, procedures, and checklists, emergency procedures including those for fire and equipment failure, weather, and medical illness or injury, lockout/tagout procedures.
- All personnel should have completed a medical fitness examination, especially those who will be exposed to hyperbaric pressure.
- Personnel should have first aid and CPR training and certification including the use of oxygen systems.
- Pre-dive and daily safety briefings should be held.
- A dive log should be kept for each diver and for each dive.
- Dives during which decompression sickness and/or pulmonary barotrauma is a potential must follow the industry-specific procedures.
- Personnel should attend a maritime and boater safety course that includes standard operating and emergency procedures.

2.9 HISTORIC BUILDING SAFETY

One of the most common concerns expressed by CRM professionals is safety in and around historic period structures. These include:

- cave-in or collapse hazards
- renovation and demolition safety (i.e., an engineering survey should be conducted prior to activities to avoid unanticipated collapse during demolition).
- puncture or cut hazards
- lead and asbestos exposure during restoration and/or examination
- confined space (cellars) hazards
- slips, trips, and falls. Special care should be taken when performing studies in the vicinity of homesteads and abandoned structures. Abandoned structures may not be stable and are also a hazard for cuts and falls from loosened or decayed building materials as well as from fencing, and refuse.
- diseases associated with contact with rodents and rodent excreta.

Many historic period structures (those still in use or in ruin) are not easily accessible, and some landowners do not allow easy access through their property to a project location. These access problems sometimes necessitate climbing or cutting fences or crossing unexpected obstacles like a stream or rivulet. Safety plans need to make CRM personnel aware of these potential hazards and address both safety and legal issues associated with fences and animal enclosures.

2.10 BACK INJURIES

Due to the nature of many cultural resources activities, back injuries are common in the industry. Back injuries can be caused by some or all of the following:

- posture
- body mechanics/work habits
- stress
- loss of flexibility
- poor conditioning

Proper lifting techniques are critical to back safety. Prevention of back injuries can include the following:

- not lifting a heavy item manually when it can be lifted with mechanical help, such as with a dolly, hand truck, or forklift;.
- checking the path of travel and removing tripping hazards
- keeping knees bent when lifting

2.11 REPETITIVE MOTION STRAIN

Repetitive motion activities are common in archaeological and cultural resources investigations that include such tasks as shovel testing and screening. Repetitive Motion Strain is not so much a disease as it is a response to excessive demands on the body without adequate time for recovery. There are individual risk factors that reportedly can influence injury due to repetitive motion, including arthritis, diabetes, vitamin B-6 deficiency, and gender. Repetitive motion strain and musculoskeletal disorders usually are caused by some type of cumulative trauma disorder precipitated or aggravated by repetitive movements or exertions. Specifically one or more of the following work factors may cause repetitive motion strain:

- repetitive or sustained static exertions;
- work performed in an awkward position or posture including poor wrist, neck and body postures;
- forceful exertions;
- mechanical and localized contact stresses;
- low temperatures; and
- vibration.

Repetitive Motion Strains also commonly referred to as: Cumulative Trauma Disorders, Repetitive Stress or Strain Injury, and Overuse Injury. Injuries most often associated with these include: carpal tunnel syndrome, thoracic outlet syndrome, tendinitis, epicondylitis (tennis elbow), Raynaud's syndrome, white finger, chronic back strain, and even stress. These individual conditions are not caused by the same exact conditions. They all, however, are caused by some trauma or stress to the body that occurs over a long period of time. Prevention includes:

- changing work location, habits or methods;
- using ergonomic tools or equipment;
- taking adequate breaks;
- learning your individual limits; and
- knowing the warning signs and learning proper stretching techniques.

2.12 SLIPS, TRIPS, AND FALLS

Tripping and falling hazards have become a major concern of OSHA over the past several decades. CRM field personnel should become familiar with the general terrain and potential physical hazards at the job site (e.g., ravines, pot holes, fencing, ledges, abandoned structures, and loose soil or gravel) which could be associated with accidental risk of slips, trips, and/or falls. Special care should be taken when performing studies in the vicinity of homesteads and abandoned structures. Abandoned structures may not be stable and are also a hazard for cuts and falls from building materials, fencing, and refuse. The obvious on site concerns in this regard are open excavation units and trenches, although just as important and equally as dangerous are tripping hazards associated with stakes, insufficient walkways around units, backdirt piles too close to units and obstructing pathways, and tools improperly left on the ground. Other CRM survey hazards include natural obstacles, such as machete-cut saplings (both downed brush and remaining pungie stick-like stumps), old brush piles, and entangled vines.

CRM workers should walk cautiously during field surveys and between shovel test locations at the site to avoid tripping or slipping, especially when uneven terrain, animal borrows, or slippery surfaces are present. Natural obstacles should be eliminated when possible, and extra care must be taken when their removal is not possible. Workers will observe all pedestrian and vehicle rules and regulations. Extra caution will be observed while driving in reverse to ensure safety.

2.13 SUN EXPOSURE

Sun exposure is one of the more important and common hazards encountered by CRM professionals in conducting field work. Sun exposure is a constant danger, although more so in the summer when the sun's rays are more direct and intense. Sunburn can occur under most lighting conditions since both short- and long-term damage is primarily the result of exposure to UVB (mutagenic) rays. Individuals working outdoors should avoid

direct exposure as much as possible. If working in the sun is unavoidable, as it often is, as much of the skin as possible should be covered (without producing heat stress) and exposed skin should be treated with sun screen (SPF 30 or greater). There are different degrees of sunburn.

Sunburn degree	Symptoms	Relief
Mild	Deep pink, heat, burning	Cool compresses, moisturizer
Moderate	Red, visible lines, itching	Anti-inflammatory to ease pain and application of over -the-counter steroid cream
Severe	Bright red, blisters, fever, chills, nausea	Cool bath with ½ cup of cooked oatmeal added, see a doctor

Baths should be cool (not cold) and should not contain oils or bath powders. If necessary, use sunburn remedies containing aloe vera and a light moisturizer to avoid chafing. Care should used when applying sun block: it should be reapplied ever few hours depending on the rate of perspiration. In addition, using sun block can engender a false sense of security in some people; after application, they tend to feel invulnerable and stay in the sun much longer than they should. For further relevant information, refer to Section 2.1 on Heat Stress.

2.14 TOOL SAFETY

Tools are a common part of cultural resources work and it is important to recognize that even if used correctly they may pose hazards. Part of the process of mitigating or avoiding tool hazards is to learn to recognize the hazards associated with the different tools and the safety precautions necessary to prevent those hazards. Some of the more common tools include:

- machete
- pocket knife
- trowel
- hatchet
- grapefruit knife
- hammer
- axe
- razor knife
- wrench
- saw
- auger
- screwdriver

Hand tools are non-powered devices that include anything from axes to wrenches to machetes. The greatest hazards posed by hand tools result from irresponsible use, misuse, improper maintenance, and the lack of common sense. Power tools can include electric, pneumatic, liquid fuel, hydraulic, and power-actuated. Personnel and employers are responsible for the proper use and maintenance of tools. Precautions include:

- Machetes, knives, saw blades, and other sharp tools should be directed away from other workers.
- Safety goggles, gloves, boots, and other appropriate protective equipment should be warn as appropriate.
- Work areas, when possible, should be kept clean and dry to prevent accidental trips, slips, falls, and electrical hazards.
- Around flammable substances, sparks produced by iron and steel hand tools, or from power tools can be a dangerous source of ignition.
- Equipment, such as tripods, screens, etc., should be properly positioned or lashed to avoid accidents.
- Hand tools, such as rakes or hoes (for clearing a unit before excavation), should be placed with tines or blade down.

Tools should be used for their intended purpose. To facilitate proper tool use, operational instructions/manual should be read and understood before the tool is used. These instructions should be followed in the field. Pre-training and practice with the tool should be provided.

TRAIL/WOODS SAFETY

Field crews often work in environments without caution signs for loose rocks, cliffs, ledges, or areas where falls, and injuries may occur. Safety in the woods is a matter of common sense and knowledge of working in outdoor environments. Most common outdoor injuries are blisters, cuts, sprains, strains, bruises, and fractures. Field crews can become lost or get caught in storms. One of the most dangerous field survey areas are thickets where both physical (trees and bushes with large needles such as hawthorn trees) and biological hazards (bees, snakes, poison ivy) can exist.

CRM crews should plan for communication to obtain assistance should an accident occur, a medical emergency arise or an evacuation be required. The use of cellular phones or walkie-talkies is recommended. Always notify office personnel of entry and exit from the woods or the field.

2.15 REMOTE SITE SAFETY

Remote work sites are loosely defined as any work locations that are distant from emergency response professionals (more than 15 minutes is a standard). Two of the first steps in addressing safety issues at remote sites are assessing the accessibility of the site and determining the time it would take for emergency personnel to arrive at the site in the event of an accident. In general, construction sites have temporary roads built to them from public roads, but this is not practical at most archaeological project areas. On site communications, such as cellular telephones or walkie-talkies, are the best method to ensure that contact is maintained between the remote site and the home office, although emergency personnel still must be able to reach the area when contacted. OSHA

requirements for a safe and healthful work environment mandate that trained emergency personnel are on site if local professionals cannot reach the site in a timely manner. (The requirement actually mandates that two trained persons be on site in case one of them is the person who becomes injured.)

Assessment of a remote site situation is not always clear but leads to the need for field crews, especially field supervisors to be very aware of their location and the availability of local emergency personnel to respond to an accident. CRM professionals should have this information readily available for each project area (generally delineated by county on linear surveys) and this information needs to be disseminated to each crew member.

2.16 UNEXPLODED ORDNANCE

Unexploded military ordnance (UXO) is a national archaeological problem on certain field projects on active or decommissioned military reservations. Military range control officers caution digging in areas where the potential for UXO exists and these areas must be cleared by military specialists prior to archaeological investigation. The "don't touch it if you find it" caution provided by most company supervisors does not comply with the OSHA HAZCOM requirement. Field crews must be informed about the potential hazard and what they may encounter, and be given the option to refuse certain tasks in such situations.

3.0 BIOLOGICAL HAZARDS RECOGNITION AND AVOIDANCE

Since archaeological and cultural resources surveys are for the most part associated with work in outdoor environments or with artifacts recently recovered from historical environments, biological hazards are a major and often overlooked concern. These hazards range from diseases spread by insects, to those associated with viruses, bacterium and fungi, to contact with poisonous and toxic plants, and blood-borne pathogens. Biological hazards can result from encounters with mammals, insects, snakes, spiders, ticks, plants, parasites, and pathogens. Mammals can bite or scratch when cornered or surprised. The bite or scratch can result in local infection with systemic pathogens or parasites. Insect and spider bites can result in severe allergic reactions in sensitive individuals. Exposure to poison ivy, poison oak, or poison sumac results in severe skin rash resulting in loss time or an OSHA reportable occurrence. Ticks are a vector for a number of serious diseases. Dead animals, organic wastes, and contaminated soil and water can harbor parasites and pathogens.

Many of these hazards can be controlled through some basic preventive measures, knowledge and common sense. During a recent archaeological survey conducted in an urban environment, for example, a survey crew was examining artifacts in and around hypodermic needles used for drugs and potentially contaminated with the AIDS virus or hepatitis B and C viruses. A recent underwater investigation was being conducted within waste-polluted waters potentially contaminated with hepatitis virus and E-coli bacteria. A specific example of the use of knowledge and common sense to prevent injury or illness can be shown by relating a recent occurrence at a job site. During a recent Phase I archaeological survey, a crew member decided to collect seeds from a gingko tree which contains the same allergen found in poison ivy (urushiol). The result was a sever reaction and OSHA reportable injury. In addition, numerous cases of allergic reaction to poison ivy and sumac are reported by survey crews.

3.1 TICK-BORNE DISEASE

Ticks can spread a number of diseases to CRM professionals who come into contact with them during field activities. It is also important to note that ticks encountered in the field can be transported back to home or office environments from the field.

During field activities, two types of ticks may be encountered: the dog tick and the deer tick. The dog tick is the larger, more common tick. After biting, the dog tick will remain attached until engorged with blood. Usually, dog ticks can be found by careful inspection of the body at the end of the work day. If the tick is already embedded in the skin, remove it with tweezers or fingers by grasping the tick as close to the skin as possible and pulling downward. Check to make sure all tick parts have been removed from the skin. Wash the area of the bite with soap and water. Seek medical attention if any tick parts remain in the skin. Dog ticks may transmit rocky mountain spotted fever and other diseases.

The deer tick is much smaller, ranging from poppy seed to grape seed size, and does not remain attached to the skin very long after biting. You may be bitten by a deer tick and never see the tick. Deer ticks can transmit a number of diseases including Lyme disease, which can have serious, long-term health effects if left untreated. If you discover a small tick embedded in the skin, remove it as described above. Check the area of the bite periodically. If you develop a rash or flu-like or other symptoms, seek medical attention.

Steps to Reduce the Likelihood of Getting Tick Bites Include:

- Tape or tuck pants to safety boots;
- Wear long sleeves, hat and closed shoes;
- Wear light-colored clothing to facilitate seeing and brushing off ticks;
- Use tick repellant, such as permenome on clothes, and a repellant containing DEET on skin. Repellants should be used sparingly and with care, as they may cause adverse reactions in some individuals;
- Perform thorough checks of body for ticks daily; and
- Shower immediately after work and wash clothes daily.

Promptly finding and removing ticks is the best preventive measure and ticks should be removed carefully and completely. If any of the mouth parts are present, toxin may still be released and symptoms or complications may occur.

LYME DISEASE

Lyme disease is caused by a bacterial infection (*Borrelia burgdorferi*, a member of the family of spirochetes [corkscrew-shaped bacteria]) transmitted by the deer tick. Lyme disease may cause symptoms affecting the skin, nervous system, heart and/or joints of an individual. Nearly 20,000 cases have been reported to the New York State Department of Health since Lyme disease became reportable in 1986. The disease was first recognized in the United States in 1975, after a mysterious outbreak of arthritis near Old Lyme, Connecticut. CRM professionals who spend time in grassy and wooded environments are at an increased risk of exposure. The risk of exposure is state-wide, although some areas of the state have more reported cases than others.

Research indicates that, for the most part, ticks transmit Lyme disease to humans during their nymph stage probably because they are more likely to feed on a person and are rarely noticed due to their small size (less than 2 millimeters or about the size of a poppy seed). Adult ticks can also transmit the disease. Deer ticks in the nymphal stage are active from mid-May to mid-August. Adult ticks, which are approximately the size of a

sesame seed, are most active from mid- to late-fall. In general, therefore, exposure to Lyme disease via ticks can occur during the spring, summer and fall.

Not all deer ticks are infected with the bacteria that causes Lyme disease. The disease can be spread when a tick infected with the bacteria bites a person and stays attached for a period of time. Person-to-person spread of Lyme disease does not occur.

Symptoms of Lyme disease may develop within a week to a few months of the tick bite. In about half to 80 percent of the cases, a large, reddish rash about 2 inches in diameter appears and expands around or near the site of the bite. Within the first week, an expanding rash, blotch, or a central spot surrounded by clear skin that is ringed with the red "Bull's Eye" rash may appear. More than one rash may appear, and not always at the bite site. Inconspicuous places, such as the armpit, groin, or back of knee, may acquire a rash. Flu-like symptoms, chills, fever, and fatigue are often experienced, but they may not seem serious enough to require medical attention. More severe symptoms may appear weeks, months, or even years after the bite and may include headaches, arthritis, and nervous system or cardiac abnormalities. Swelling and pain in the large joints may recur over many years. These signs may occur at different times and the rash may not appear. If any bites on the skin are discovered, wash the affected area and seek medical attention if a rash or flu-like symptoms appear.

Treatment for Lyme disease includes the use of antibiotics. Prognosis improves with prompt diagnosis and appropriate, early treatment.

Babesiosis

Babesiosis is a rare, severe and sometimes fatal tick-borne disease caused by an infection with a red blood cell parasite. Cases of it have been reported during spring, summer, and fall in mostly coastal areas and are found most frequently in immunocompromised individuals or the elderly. The disease is transmitted by the bite of an infected deer tick.

The symptoms of babesiosis include fever, fatigue and hemolytic anemia lasting from several days to several months. It can take from one to twelve months for symptoms to occur and infections can occur without producing symptoms.

Ehrlichiosis

Ehrlichiosis is a tick-borne disease caused by a bacteria. Most cases reported in New York have been in Westchester County and the lower Hudson valley. Ehrlichiosis is believed to be spread by the bite of an infected deer- , dog- or lone star- tick and cannot be spread from person to person.

The most common symptoms include fever, muscle aches, weakness, and headache. Victims can also experience confusion, nausea, vomiting and joint pain. The incubation period is usually one to three weeks.

ROCKY MOUNTAIN SPOTTED FEVER

Rocky Mountain Spotted fever (RMSF), a tick-borne typhus fever, is a disease caused by a rickettsial organism transmitted to humans by the bite of an infected American dog tick, or other tick species. Fewer than 50 cases are reported each year in New York with most of them occurring in Long island.

RMSF is characterized by the sudden onset of moderate to high fever (which can last from two to three weeks), severe headaches, fatigue, deep muscle pain, chills and rash. The rash begins on the legs or arms, but can include the soles of the feet or palms of the hand, and may spread rapidly to the trunk or the rest of the body. Symptoms usually appear within two weeks of the bite.

TICK PARALYSIS

Tick Paralysis is a rare tick-borne illness caused by a neurotoxin from the salivary glands of certain species of female ticks. Frequency estimates of this condition in New York is about one case every two years. Symptoms include fatigue, numbness of the legs, and muscular pain occurring five to seven days after tick attachment. If the attached tick is not found and removed, the condition can worsen, resulting in difficulty swallowing, and tongue and facial paralysis. The most severe complications include convulsions, respiratory failure, and even death.

3.2 MOSQUITO-BORNE DISEASE

The more important diseases transmitted by mosquitoes are dengue or breakbone fever, encephalitis, filariasis, malaria, Rift Valley fever, and yellow fever. Of these only malaria and the encephalitis have been identified in the United States and these diseases are not common in New York State. However, since many CRM professionals also work outside New York State and often in areas where mosquito-borne diseases can be a major cause of illness and death, a summary of the disease hazard associated with mosquitoes is presented in this section.

Mosquitoes breed in water such as edges of ponds, streams, in salt marshes, holes in stumps or trees, open cesspools, water barrels, catch basins, discarded tires, etc. Only the female mosquito feeds on the blood of humans and animals. (The male feeds on the nectar from flowers.) Mosquitoes may travel several thousand yards in search of a meal and can travel long distances via trains, planes, boats, and automobiles.

CRM professionals should be cognizant of mosquito-borne diseases, especially if travel to endemic areas is planned. In general, workers can protect themselves from mosquito bites by wearing proper clothing (light colored, long sleeves, and pants with bottoms tucked into boots or socks), applying an insect repellent to exposed skin and clothing, and if possible, avoiding high risk situations, such as performing outdoor activities during peak biting times (at night between dusk and dawn), and utilizing unscreened living or sleeping

accommodations. Portable mosquito netting is available and should be used when work is done in disease areas. Excessive and prolonged use of repellents should be avoided and manufacturer's recommendations for the proper use should be strictly followed.

Arboviral infections (such as encephalitis) are caused by any number of viruses transmitted by arthropods, such as mosquitoes and ticks. Most arboviral infections are spread by infected mosquitoes and these infections usually occur during warm weather months when mosquitoes are active. Fortunately, only a few types of mosquitoes are capable of transmitting the disease and even less carry the virus.

Malaria is a mosquito-borne disease caused by one of four different blood parasites. Although not common in the United States, the disease is the leading cause of debilitating illness in the world. Thus far, most cases reported in the United States are acquired in foreign countries where the disease is endemic. However, certain species of mosquitoes found in the United States are capable of transmitting the disease after acquiring it from an infected person who got the disease elsewhere. In almost all of the cases of malaria reported in New York State each year, the disease was acquired in foreign countries. However, a few locally-acquired cases have been reported on Long Island and in Queens.

Symptoms include fever, chills, sweats and headache, and in some cases may progress to jaundice, blood coagulation defects, shock, kidney and liver failure, central nervous system disorders, and coma. Cycles of chills, fever, and sweating that occur every one, two, or three days in a person returning from a tropical area is a good indication of malarial infection.

3.3 AIRBORNE/PARTICULATE-BORNE FUNGI

Airborne particles, such as dust and droplets, can carry pathogens that when inhaled cause infectious diseases. These types of infectious diseases are transmitted by airborne pathogenic bacteria, viruses, and fungi that flourish when entering the warm, moist environment in the upper and lower tracts of the respiratory system.

CRM professionals spend a large amount of time in dusty environments. Fungus-borne diseases that can be transmitted by airborne dust particles include coccidioidomycosis, mucormycosis, histoplasmosis, cryptococcoses, and blastomycosis. Most of these diseases are rare in New York, especially in upstate New York. Birds (especially chickens), bats, dogs, cats, rats, skunks, opossum, foxes and other animals can acquire fungus-borne diseases and may play a role in spreading the disease. CRM professionals can become infected with these diseases by inhaling the spore stage of the fungus. Outbreaks have been known to occur with exposure to bird or bat droppings, as well as recently disturbed, contaminated soil found in chicken coops, caves, and other areas where contaminated animal droppings may occur.

CRM professionals working in dusty areas potentially contaminated with airborne pathogenic bacteria, viruses, and fungi should minimize exposure to dust, especially in

contaminated enclosed environments, through the use of respiratory protection and water sprays or other dust suppression techniques. Specific examples of cultural resources exposure potentials, at risk environments, and control methods are summarized in the discussion on hantaviruses below.

3.4 HANTAVIRUSES

Hantaviruses are a family of viruses found in rodents in different parts of the world. In 1993, a previously unrecognized hantavirus was identified as a causative agent of a severe respiratory disease in the southwestern United States, which was subsequently named hantavirus pulmonary syndrome (HPS). Recently, sporadic cases have been reported in several eastern states. The virus is believed to be carried by rodents especially the deer mouse which has been identified as the primary rodent reservoir. Infected rodents shed live virus in saliva, droppings, and urine, and humans are infected when they inhale particles that contain the virus. Deer mice and other rodents are highly adaptable and are found in many different habitats including urban, rural and semi-rural environments with which CRM professionals often come in contact.

Symptoms of HPS include one or more of the following: fever, muscle aches, headache, cough, and progresses rapidly to severe lung disease, sometimes requiring intensive care treatment.

Hantavirus infections to date have occurred primarily in adults associated with domestic, occupational, or leisure activities that bring people into contact with infected rodents and dust/particle infected saliva or excreta. It has been speculated that transmission may occur when dried materials contaminated with the virus are introduced directly into broken skin, eyes, or possibly during consumption of contaminated food and water.

Cultural resources activities are often conducted in areas that contain rodents, rodent nests, and potentially contaminated materials, including artifacts that have been contaminated with rodent excreta. CRM professionals should consider their potential risk when working at or visiting sites, or when cleaning or handling artifacts recently contaminated by rodent excreta.

Examples of locations where CRM professionals can typically come into contact with rodents and rodent excreta include:

- historic structures especially abandoned structures;
- trash and "pack-rat" middens;
- human burial sites because of soft dirt, wall collapse, artifacts, and human remains offer suitable shelter and nesting areas;
- caves and rockshelters;
- backdirt piles, storage areas, and temporary structures such as offices, labs, or temporary housing established at survey sites especially those left in place for long periods;

- artifact examination areas in museums and laboratories that are accessible to rodents.

CRM professionals should take precautions whenever rodents or their droppings are encountered. Guidelines for reducing the risk of exposure include:

- **Inspection and Clean Up** - Assess the level of rodent activity at work areas through inspection including looking for signs of rodent activity such as droppings, burrows, gnawing, runways, tracks, and rubmarks. Museums should routinely check for rodents. Clean up of rodent feces and nests should be performed using disinfectants and protective clothing.
- **Trapping** - Place snap traps in areas where rodents are active. Move traps periodically.
- **Poisoning** - Use poison baits outdoors and away from current work stations. Poisoning should be conducted well in advance of activities when possible.
- **Carcass Disposal** - While wearing rubber gloves, remove carcass using a long-handled shovel and double-bag in plastic bags. In plague-endemic areas, insecticides and disinfectants should be used in accordance with manufacturer instructions.
- **Rodent Proofing** - Passages that permit rodent entry into offices, laboratories, museums, and other areas should be closed off using steel wool or wire mesh. Any opening bigger than a rodents head is big enough for rodents to enter. Walls, roofs, doors, windows, ground floors, basements, and crawl spaces should be rodent-proofed. Wood piles and other clutter should be kept away from structures.
- **Sanitation** - Food and other attractants should be kept in secure containers. Sweeping or vacuuming feces should be avoided to reduce dust.
- **Protective Clothing** - High Efficiency Particulate Air filters (HEPA) respirators may lower the risk of virus transmission in heavily rodent-infested areas and dusty environments. Eye and hand protection is also recommended.

(adapted from Center for Disease Control (CDC) recommendations and an article by T.M. Fink and P.S. Zeitz, *Hantavirus Pulmonary Syndrome and Field Archaeology: Guidelines For Risk Reduction,* Journal of Field Archaeology, Volume 23 Number 4, Winter 1996)

3.5 RABIES

Rabies is a viral disease affecting the central nervous system. It is usually transmitted from infected mammals to humans through a bite, although scratches and saliva contact with broken skin are other routes. To avoid exposure to rabies, CRM personnel should avoid

all wild animals. Rabies is treatable if treatment is started soon after infection. If confirmation that a wild animal has rabies cannot be made, medical treatment of any bites should occur. Rabies is not curable once symptoms or signs of rabies appear, stressing the need for immediate medical attention.

3.6 TETANUS

Tetanus, commonly called lockjaw, is a bacterial disease that affects the nervous system. The tetanus bacteria is present throughout the environment and is commonly found in soil contaminated with manure.

The symptoms of tetanus infection include muscular stiffness in the jaw (lockjaw) followed by stiffness of the neck, difficulty swallowing, rigidity of abdominal muscles, spasms, sweating, and fever. Complications include spasms of the vocal cords and/or the respiratory muscles causing interference with breathing. A wide range of other complications can also occur.

CRM personnel should maintain a high level of immunization against tetanus. Wounds should be thoroughly cleaned, and dead or devitalized tissue removed. If a tetanus toxoid booster has not been provided in the previous ten years, CRM professionals should consider receiving a booster injection prior to field work or the same day a wound occurs.

3.7 BLOOD-BORNE PATHOGENS

Blood-borne pathogens are defined as pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV). Federal OSHA regulates occupations which are potentially exposed to blood-borne pathogens (29 CFR 1910.1030). Occupation exposure is defined as reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from performance of an employee's duties. OSHA requires that employers who have employees with potential occupational exposure to blood-borne pathogens establish a written Exposure Control Plan (ECP) designed to eliminate or minimize employee exposure.

In most cases CRM professionals do not perform activities that potentially expose them to blood-borne pathogens. There are, however, certain tasks which place individuals at risk and specific categories of CRM professionals who may be at a high level of risk. Examples include survey work in environments that may include potential exposure to discarded hypodermic needles, underwater surveys in contaminated environments, certain types of forensic archaeology, and other tasks that place personnel in direct contact with wastes from hospitals, municipal waste sites, medical laboratories or facilities.

CRM Professionals who are at risk of exposure to blood-borne pathogens through occupational exposure should develop an ECP. These ECPs should address the following:

- Requirements of 29 CFR 1910.1030.

- Employee risk classifications and the identification of specific tasks/jobs that create a potential risk of exposure. Employees should be classified within a formal program according to tasks and the potential exposure to blood-borne pathogens. Classifications typically include one for tasks that routinely involve potential exposure such as soil, water or artifact collection at municipal waste sites, or near medical facilities. One for tasks that do not normally involve exposure, but may require unplanned tasks that represents increased exposure such as simple field surveys, contaminated artifact examination, or rendering first aid as a collateral duty in response to a workplace incident. One for jobs involving no potential occupational exposure such as office personnel.

- Compliance approaches, methods and schedules associated with hazard control including universal precautions (assumes precautions based on treating all human blood and body fluids as containing pathogens), work practice controls, engineering controls, personal protective equipment, and housekeeping.

- Medical surveillance and vaccination protocols.

- Exposure incident evaluation and reporting.

- Employee training.

- Personal hygiene protocols.

Blood-borne pathogen training should include the following topics:

- Review of the OSHA standard and company policies including the ECP

- Overview of the routes of exposure, mode of transmission and symptoms of disease transmission including specific information on HBV and HIV

- Review of hazard control methods including engineering, administrative and work practices, and personal protective equipment

- An explanation of the signs and labels and/or color coding associated with the standard

- Medical surveillance and vaccination

Universal precautions include practices such as the following:

- Assuming that all blood, tissue, and body fluids or equipment/materials that may have been contaminated by these substances are infected.
- Wearing appropriate protective clothing, such as impervious gloves, gowns and aprons, goggles, etc., if contact or splattering of contaminated material is anticipated.
- Washing hands or other body parts (minimally with soap and water or antiseptic cleansers and towelettes) that come into contact with contaminated materials.
- Ensuring that mouthpieces and appropriate protective equipment are readily available in first aid kits.
- Handling sharp objects carefully and avoiding contact with needles or vials.
- Disposing of all potentially contaminated materials in accordance with hazardous waste disposal requirements outlined in the OSHA standard.
- Eating, drinking, smoking, applying cosmetics, and handling contact lenses should be prohibited in work areas where potential blood-borne hazards exist.

Infectious control kits can be obtained which contain the material and supplies needed to control blood-borne pathogen hazards.

3.8 DERMATITIS-CAUSING POISONOUS PLANTS

Dermatitis caused by contact with poisonous plants is one of the leading causes of missed time, doctor visits and OSHA-reportable events for archaeological and cultural resources field crews. Three plants commonly encountered during fieldwork that cause dermatitis when contacted are poison ivy, poison sumac, and western poison oak. These plants have poisonous sap contained in resin canals in their roots, stems, flowers, and leaves. Released when the plant is bruised, the sap may be deposited on the skin by direct contact with the plant or by contact with contaminated objects, such as shoes, clothing, tools, artifacts, samples, and animals. Severe cases have occurred when plants are burned and sap-coated soot comes into contact with skin and causes severe reactions with lung tissue. The rash, which is a type of allergic reaction, is actually caused by the body's reaction to urushiol (a mixture of phenolic compounds) in the sap rather than the sap itself.

Most people develop symptoms within 24 to 48 hours after contact depending on individual sensitivity and the amount of sap contacting the skin. Healed areas often remain supersensitive to further contact for several months. The first symptom of poisoning is a severe itching of the skin followed by a red inflammation and blistering of the skin. In severe cases, oozing sores develop. The rash spreads by contact/spread of sap and not as a result of sores. Most cases disappear in a week to ten days. Less severe cases can be treated using over-the-counter medications, such as hydrocortisone. Individuals with severe cases (rashes covering large areas or accompanied by above-normal body temperature) should consult a physician. Medical treatment is more effective if applied before oozing sores appear.

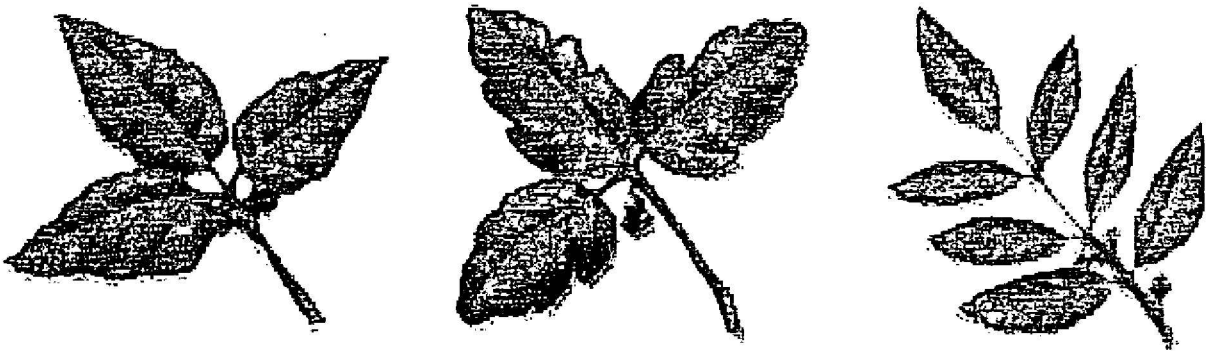
Skin that comes into contact with sap should be washed as soon as possible since skin can absorb the active compounds within the first three minutes. Areas exposed to sap should be washed as soon as possible with cold water to minimize the severity and the spread of the sap to uninfected parts of the body. Opinions regarding the use of soap and water vary. Some believe the use of soap and water is superior to water alone in removing the sap, however, soap can also temporarily remove a natural protective layer that helps keep the active antigenic compounds from being absorbed through the skin and any scrubbing action could actually spread the urushiol. The sap must penetrate the skin before poisoning results and therefore areas of thin skin may be more susceptible than areas of thicker skin or heavy body hair. However, within five minutes the urushiol will have bonded with the epidermal cells and nothing more can be done. Clothing can be decontaminated by laundering with soap or detergent. Note that exposure can occur from unwashed clothing.

Despite claims of immunity to the poisonous sap, no person is completely immune, according to clinical evidence, although individual sensitivity varies greatly. In order for someone to develop a reaction to the sap, he or she must first be sensitized to it. People are not born with an allergy to the sap, rather the body must first become sensitized to the sap after repeated exposure. For some individuals, if a long period of time separates exposures, that person's sensitivity may significantly decrease to the point that at the next exposure to the plant, no reaction occurs. **It is important to note, severe cases of poisoning have occurred after supposedly immune individuals have purposely rubbed leaves onto their skin.** No acceptable method of immunization is known.

The best way to avoid poisoning is to learn what these plants look like and avoid contact with them. However, identification in the field is sometimes difficult, and in the case of poison ivy, the plant can be quite ubiquitous making avoidance almost impossible. An old adage may come in handy: "Leaves of three, let it be; berries white, poisonous sight."

Poison Ivy

Poison ivy grows primarily as a vine except in the Great Lakes region where it grows as a shrub. CRM field survey personnel should become familiar with the appearance of the poison ivy plant prior to fieldwork and during the safety briefing. CRM personnel should



POISON IVY (Rhus toxicondendron L.)

POISON OAK (Rhus diversiloba)

POISON SUMAC (Rhus toxicondendron vermix)

Figure 2 - Typical configurations of poison ivy, oak and sumac.

avoid walking through areas of heavy growth, when possible. If crews must walk through areas of poison ivy, extremities should be kept covered and contact between bare skin and poison ivy leaves and stems should be avoided. When digging in areas of poison ivy growth, contact with the roots should be avoided. Clothes, tools, artifacts, etc., should be handled with care and washed or cleaned prior to reuse.

Poison ivy is a perennial, glossy plant that spreads by seeds and woody rhizomes. The plant can be a trailing vine, aerial-rooted vine or a shrub. Poison ivy leaves are alternate and consist of three leaflets; the middle one has a stalk much longer than those of the two lateral leaflets (Figure 2). The edges of the leaflets may be smooth or serrated, but they are rarely lobed. The leaves vary greatly in size from 8 to 55 mm in length. The leaves are reddish when they first emerge in the spring and green during the summer. They are various shades of yellow, orange, red, or bronze in the fall. Male and female flowers, normally found on separate plants, are clustered, small, and cream to yellow green in color. The green to yellow fruits are clustered, loose, and waxy, and are 3 to 7 mm in diameter.

Poison Oak

See poison ivy, its eastern counterpart.

Poison Sumac

Poison sumac is a tall shrub or small tree typically found in wooded swamps. The leaves consist of 6 to 12 leaflets arranged in pairs with an additional single leaflet at the end of the midrib. The small yellowish green flowers, formed in clusters, mature into whitish green fruits that hang in loose clusters 10 to 30 cm in length. The male and female flowers of the poison sumac are on separate plants, as with poison ivy and western poison oak. Non-poisonous sumac species have leaves similar to those of the poison sumac except that the fruits are distinctive—red, erect, and have cone-shaped terminal heads, not the hanging whitish green fruits of the poison variety.

3.9 OTHER BIOLOGICAL HAZARDS

A plethora of other biological hazards exist which may impact CRM professionals. Exposure to these hazards will depend on the nature of the activities and job functions performed. Some additional hazards are covered briefly below. These problems are magnified when coupled with concerns of remote work locations (See Section 2.15).

WILD AND DOMESTIC ANIMALS

Wild and domestic animals can pose problems on surveys for field personnel, and are a greater physiological threat than a physical one. Fear of bites, scratches or attacks is founded on the real dangers these animals present. Dogs, cattle, horses, and goats can be troublesome and many landowners are reluctant to chain, pen, or otherwise secure their animals. Legal liability also can be an issue here. Prevention measures (such as those detailed below) need to be addressed to reduce the threat of injury caused by these creatures.

SNAKES

New York is within the habitat range of rattlesnakes and copperheads. Snakes are most active in spring and summer and not active in late fall and winter. The copperhead can grow to 36 inches and has a copper-colored head. The body has a reddish-brown hour glass pattern. Rocky hillsides are the copperhead's favorite habitat. The rattlesnake is characterized by the distinctive rattler on its tail.

A snake bite is characterized by extreme pain and rapid swelling, the presence of one or more puncture wounds, and skin discoloration. Effects of a snake bite can include weakness, rapid pulse, nausea and vomiting, shortness of breath, dimness of vision and shock.

If a snake bite occurs, the injured personnel should be transported to a medical facility within 30 minutes. First-aid should consist of applying a constriction band and washing the area around the wound. Cutting the wound and sucking the venom should be avoided unless medical care cannot be obtained in 30 minutes.

Field crews should do the following to minimize the chance of snake bites:

- Do not put hands or feet where you have not looked;
- Avoid stepping into clumps of weeds and brush;
- Step heavily. Snakes can feel footfalls through the ground and will avoid you if they can; and
- Wear heavy leather boots and loose fitting pants.

Caution should be used if any snake is encountered.

Bees, Ants, Wasps and Hornets

Field survey crews and historic preservation professionals are at increased risk of stinging and biting insects because their tasks place them in areas prone to encounters. Nests and hives for bees, wasps, hornets, and yellow jackets often occur in the ground, trees, brush, and within structures, such as houses, abandoned structures, and artifacts that create suitable nesting areas.

Field personnel should survey work locations for signs of nesting areas and employ avoidance. Before any nests or hives are disturbed, an alternate survey location should be selected, if possible. If the survey location cannot be relocated, site personnel who may have allergic reactions to these insect stings shall not work in these areas.

Sensitization by the victim to the venom from repeated stings can result in anaphylactic reactions. If a stinger remains in the skin, it should be removed by teasing or scraping, rather than pulling. An ice cube placed over the sting will reduce pain. An analgesic-corticosteroid lotion is also often useful. People with known hypersensitivity to such stings should consult with their doctor about carrying a kit containing an antihistamine and aqueous epinephrine in a prefilled syringe when in endemic areas.

Hepatitis A and C

Hepatitis A is a liver disease caused by a specific virus. The disease is fairly common with more than 1,000 cases reported each year in New York State. This disease is transmitted by the fecal-oral route through direct person to person contact from contaminated water, ice or shellfish, or from fruits or uncooked vegetables contaminated through handling. The CDC recommends hepatitis A vaccine or immune globulin (IG) for protection against this disease when working in high risk areas, such as work in unsanitary conditions (i.e., underwater surveys near sewer outfalls).

Hepatitis C (serum Hepatitis) is a liver disease caused by a blood-borne virus and approximately 200 cases are reported each year in New York State. This disease is transmitted through blood transfusions or through contaminated needles. Precautions include those covered above in Section 3.7 above on blood-borne pathogens.

E. Coli

E. Coli are bacteria that normally live in the intestines of humans and animals. Although most strains are harmless, several strains produce toxins that can cause mild to severe health hazards ranging from mild to severe diarrhea and cramps, to kidney damage and even death. The bacteria can be acquired through consumption of contaminated food or water, or through person to person contact. Eating meat that is rare or undercooked is the most common cause of the disease.

TULAREMIA

Tularemia is a bacterial disease associated with exposure to infected animals through the inoculation of the skin or mucous membranes with blood or tissue while handling infected animals; contact with fluids from infected deer flies or ticks; or handling or eating undercooked game animals especially rabbit. Field crews should avoid the bites of deer fleas and ticks, and avoid drinking or entering untreated water. Tularemia in humans is relatively rare in New York State. Symptoms include the presence of a lesion and swollen glands. Ingestion of contaminated food or water may produce a throat infection, intestinal pain, diarrhea and vomiting.

LEPTOSPIROSIS (WEIL'S DISEASE)

Leptospirosis is a bacterial disease associated with wild and domestic animals. Leptospirosis is primarily an occupational disease that affects farmers, sewer workers, and other occupations that involves contact with animals including rodents. This disease is spread mainly by the urine of infected animals. The symptoms include fever, headache, chills, vomiting, jaundice, anemia, and sometimes rash. This disease can be quite serious and require hospitalization.

GIARDIASIS (BEAVER FEVER) AND PARASITIC INFECTIONS

Giardiasis is an intestinal illness caused by a microscopic parasite called *Giardia lamblia*. It is a fairly common cause of diarrheal illness with several hundred cases in New York State. The disease is spread through contact with feces of infected persons or animals or through contaminated food or water. In general parasitic infections are acquired by eating or drinking contaminated food or water, through direct contact with soil or water containing parasites or their larva, or by contact with biting insects.

ANTHRAX

Anthrax is a bacterial disease that can infect all warm-blooded animals including humans. This disease is primarily an occupational disease especially for those who are exposed to dead animals, and animal products such as wool and hair. The anthrax bacteria can live in soil for many years and a primary route of exposure is through inhalation of contaminated soil, dust or hair particles. The disease can be fatal if left untreated. It was common practice in the past to bury contaminated domestic animals in common graves.

PLAGUE

Plague is a serious disease caused by an infection with a type of bacteria that is found in rodents and transmitted to humans by fleas. This disease is currently rare in the United States, and is limited to the western and southwestern parts of the country. There have been no reported cases of plague in New York State. CRM professionals working or visiting areas with infected rodents are at greater risk to the disease. Individuals can

reduce their potential exposure by following the information presented in Section 3.4 above on hantaviruses.

4.0 CHEMICAL HAZARD AWARENESS/AVOIDANCE PROGRAM

CRM professionals have the potential to be exposed to chemical hazards during a wide variety of both terrestrial, underwater, and laboratory/curation activities including:

- Surveys at hazardous waste sites or during hazardous, toxic, and radioactive waste operations.
- Surveys in historical industrial areas or within present-day industrial environments.
- Cleaning/inspection of industrial era artifacts or material containing toxic substances.
- Laboratory curation using toxic/hazardous substances.
- Exposure to pesticides, herbicides, and fertilizers during surveys in agricultural or residential areas (i.e., farm fields, next to an orchard that is being sprayed, during or just after lawn treatments).

4.1 TOXIC SUBSTANCES

A toxic substance is any substance that can cause acute or chronic injury to the human body, or is suspected of being able to cause disease or injury under some conditions. Many toxic substances are chemicals or chemical mixtures, but there are other kinds of toxic substances as well (bacteria and viruses, for example). This section covers potential exposures of CRM professionals to hazardous/toxic chemicals. A toxic chemical only becomes hazardous when personnel are exposed to it at levels causing health effects.

CRM professionals have the potential to be exposed to a wide variety of toxic substances in the workplace. Hazards include physical illnesses ranging from skin irritation to death. Work involving potential exposure to toxic chemicals requires compliance with the OSHA Hazard Communication Standard (1910.1200). Hazard Communication is covered in Section 7.0.

Training requirements for CRM professionals should include:

- Physical and health hazards of the specific substances and job/task functions
- Reading and understanding labels and material safety data sheets (MSDSs)
- Personal protective equipment and health and safety planning
- Safe handling, storage, and disposal practices
- Emergency response procedures and first aid

4.2 HAZARDOUS WASTE FIELD OPERATIONS

A hazardous waste operation is any physical location where a chemical, biological, toxic, or radiological waste is treated, stored, or disposed. A hazardous waste site is any

physical location where wastes are present or have been released into the environment in an uncontrolled manner or state that poses a potential health hazard.

Work conducted at hazardous waste sites is governed by OSHA 29 CFR 1910.120 - Hazardous Waste Operations and Emergency Response. Hazardous waste site work can involve CERCLA/SARA (Superfund) projects, RCRA treatment, storage, and disposal projects or RCRA corrective action projects, underground storage tank investigations, and emergency response projects.

CRM professionals are becoming increasingly involved in work at hazardous waste sites and operations such as work associated with military base closings or historic preservation at RCRA facilities or old vacant industrial facilities. The level of training, medical monitoring, and other requirements will depend on the nature of the tasks to be performed.

Typically, CRM professionals are retained as a subcontractor to supply specialty services during hazardous waste site operations. Firms that hire CRM professionals for work at hazardous waste sites are required to inform the professionals of the health and safety hazards, requirements, and emergency response procedures. Cultural resources firms that are hired either directly by a client or as a subcontractor, however, must be cognizant of and follow the requirements of OSHA. Employers or prime contractors typically meet these requirements by developing a formal written company health and safety policy and procedures program, requiring that all subcontractors maintain a health and safety program and by providing a site-specific safety plan to all workers.

The following requirements typically apply to work at hazardous waste operation per 29 CFR 1910.120 and standard practices:

- Field personnel must have either the 40-hour or 24-hour (based on the type of site and job function) OSHA health and safety training and the 8-hour annual refresher training.
- Field supervisors must have 8-hour OSHA supervisor training.
- Field personnel must be participating in a medical surveillance program.
- Field operations should be governed by a site-specific health and safety plan that meets OSHA requirements.
- A field crew member should be designated as a site-safety officer and be responsible for the safe and healthful performance of work by the crew in accordance with the site-specific health and safety plan.
- Field personnel must be trained in the proper use of protective equipment and only trained personnel should operate monitoring equipment designed to monitor the health and safety of field personnel.

Prior to the initiation of field work, prime contractors (i.e., engineering firms, federal agencies) typically require that any subcontractor submit in writing verification that all field personnel have completed training in accordance with 29 CFR 1910.120 (e), and that field

personnel are participating in a medical surveillance program in accordance with 29 CFR 1910.120 (f). Subcontractors such as cultural resources firms are also typically required to provide, for their own use, a site-specific health and safety plan (refer to Section 5).

Company health and safety programs typically include the following:

- Designated Corporate/Office Health and Safety Managers and Company Policies which denote lines of authority and responsibility
- Personal Protective Equipment Program (29 CFR 1910.120 (g))
- Medical Surveillance Program (29 CFR 1910.120(f))
- Training Policy (29 CFR 1910.120(e)
- Respiratory Protection Program (29 CFR 1910.134)
- Exposure Monitoring Program (29 CFR 1910.120(h))
- Hearing Conservation Program (29 CFR 1910.95)
- Hazard Communication Program (29 CFR 1910.120.1200)
- Construction Safety Program (29 CFR 1926) and programs specific to the industry (i.e., trenching and excavation)
- Underwater Operations and Boating Safety Programs
- Blood-borne Pathogens Program (29 CFR 1910.1030)

CRM employees working at hazardous waste sites are required to attend training that will enable them to perform their work in a safe manner. Training should be conducted by experienced individuals and documentation should be provided. Training programs for hazardous waste work operations typically includes:

- 24- or 40-Hour initial training
- On-the-Job training
- 8-Hour annual refresher training
- 8-Hour additional training for supervisor

The content of training programs typically includes:

- regulatory overview
- chemical, radiological, physical, and biological hazard recognition
- personal protective equipment, levels of protection and personnel exposure guidelines
- monitoring instruments
- general safety and safe work practices
- heat/cold stress
- engineering, administrative and personnel protection controls and limits
- basic toxicology relating to understanding signs and symptoms of exposure
- medical monitoring approaches
- decontamination methods

- health and safety plans, emergency response and contingency planning
- industry specific training such as trench safety, dive safety, confined space entry, construction/demolition safety, woodsman safety, etc.

4.3 LABORATORY SAFETY

Laboratory work associated with cultural resources activities typically does not involve the types of materials and safety hazards found in laboratories associated with other environmental professions (i.e., sample analysis for chemical contamination). Depending on the type of cultural resources discipline, however, laboratory activities and associated hazards can vary widely. Typical cultural resources and archaeological laboratory activities involve cleaning, examining, describing , and curating artifacts which involves little if any use of hazardous materials. CRM professionals performing these types of laboratory activities should be aware, however, of the potential chemical, radiological, and biological hazards associated with the artifacts themselves (toxic material), materials contained within artifacts (contaminated or toxic liquids, or residue) or environmental media associated with the artifact (contaminated soil).

Laboratory work associated with certain curation processes and forensic disciplines may involve laboratory hazards related to toxic chemicals, biological agents, and physical hazards such as exposure to ionizing radiation, lasers, etc.

The OSHA standard concerning Occupational Exposure to Hazardous Chemicals in Laboratories (29 CFR 1910.1450) applies to all laboratories used and operated by CRM professionals. When chemicals are used in a laboratory setting, a written laboratory-specific Chemical Hygiene Plan that is capable of protecting employees from chemical hazards should be developed and implemented. For cultural resources activities, this plan should additionally include protocols for potential exposure to biological and physical hazards. This plan should be reevaluated annually and be readily available to employees.

The OSHA standard requires a training program that should include the following location-specific information:

- regulatory requirements including requirements of the standard and exposure limits
- location and contents of the Chemical Hygiene Plan and MSDSs
- physical and chemical hazards including exposure signs and symptoms
- monitoring
- administrative, engineering, and personnel protective controls
- emergency procedures

Typical material contained in a location specific Chemical Hygiene Plan includes:

- standard health and safety procedures specific to the work performed and processes involved

- control measures and criteria (i.e., task-specific required use of fume hoods, personal protective equipment, lock-out, tag-out, etc.)
- maintenance and use of protective, monitoring, and ventilation equipment such as fume hoods, air velocity meters, fire alarm and suppressant equipment
- information and training requirements, schedules, and policies
- lines of authority and approval
- medical monitoring protocols
- provisions for upgrade of protocols, protection, or procedures

It is important to note that individuals packaging and shipping artifacts and other material to agencies, museums, groups, laboratories, or other CRM professionals should clearly inform and/or label the shipments concerning any potential hazards (i.e., asbestos, lead, industrial waste, radioactivity).

4.4 ENVIRONMENTAL MEDIA

For the purposes of this document environmental media is defined as:

- soil,
- surface and groundwater,
- air, and
- plants.

These various forms of environmental media can become contaminated with hazardous levels of toxic chemicals from a number of sources. In turn, CRM professionals have the potential to come into contact with contaminated environmental media during a wide variety of both field and laboratory activities. Prior to performing activities associated with environmental media (e.g., surveys, sieving, inspections, cleaning and curation), especially in areas of known hazardous, industrial or agricultural use, CRM professionals should develop a safety consciousness and take appropriate precautions. Work at hazardous waste sites should be directed as described above. When work is being conducted at locations that are not designated as hazardous waste sites, CRM professionals should consider contamination possibilities prior to engaging in work activities.

Environmental media can be contaminated with various hazardous compounds such as petroleum hydrocarbons from industrial processes or leaking underground storage tanks; solvents and chlorinated hydrocarbons, such as those associated with pesticides or leaks from commercial establishments (i.e., dry cleaners); metals such as lead, chromium, nickel, etc. from industrial operations such as smelting; polyaromatic hydrocarbons associated with various industries such as railroads, coal and coke plants; polychlorinated biphenyls (PCBs) associated with various oil-filled electrical equipment; and numerous other constituents.

4.5 ASBESTOS

Asbestos is a generic term applied to a wide chemical variety of naturally occurring mineral silicates which are separable into fibers. Asbestos fibers may be packed, woven, or sprayed and were used in various commercial applications including: roofing and flooring products (vinyl tiles); fireproofing textiles; friction products; reinforcing material in cement, pipes, sheets, and coating materials; and thermal and acoustical insulations.

Asbestos fibers find entry into the body by inhalation and ingestion. Asbestos exposure can result in a number of diseases including the chronic and debilitating disease called asbestosis, lung cancer, cancer of the chest and abdominal lining called mesothelioma, and cancers of the esophagus, stomach, colon, and other organs. Asbestos acts as a potent cancer-causing agent in combination with smoking.

One of the most common tasks that place CRM professionals at risk to exposure to asbestos is during historic building inspections and historic preservation activities, especially if asbestos abatement or demolition is being performed. Personnel involved with cultural resources activities that involve exposure to asbestos should be cognizant and follow the applicable sections of the OSHA standard in 29 CFR 1910.1001, the federal OSHA Construction Asbestos Standard (in 29 CFR 1926.58), and the Environmental Protection Agency (EPA) regulations governing the Asbestos Hazard Emergency Response Act (AHERA) (in 40 CFR 763). If CRM professionals are conducting activities where there is a reasonable expectation of exposure to airborne concentrations of asbestos at or above the action level and/or excursion limit, they should receive training in compliance with 29 CFR 1910.1001 and 29 CFR 1926.58. Action level refers to an airborne concentration of asbestos fiber of 0.1 fiber per cubic centimeter of air (f/cc) which is calculated over an eight-hour time weighted average. Excursion limit refers to an airborne concentration in excess of 1.0 f/cc as averaged over a sampling period of 30 minutes.

CRM professionals who may be exposed to asbestos above OSHA limits should be trained in the following topics:

- health effects associated with exposure
- relationship between smoking, asbestos exposure and lung cancer
- typical uses and locations associated with asbestos
- job-specific activities that could result in exposure
- administrative, engineering, work practices, and protective equipment used to reduce exposure
- medical surveillance approaches
- air and exposure monitoring

4.6 LEAD AND OTHER METALS

Exposure to "heavy metals" has become a problem in the United States in the wake of massive industrial pollution (especially in down-wind situations). Heavy metals are not always listed as toxic, but exposure to them is linked to a variety of long-term health problems. Metals such as nickel, cadmium, and zinc are associated with a number of industrial activities in the eastern United States over the past 150 years. Lead is also a problem, and is compounded by its use in residential settings. Heavy metal contamination generally occurs in the plow zone of areas down-wind of industrial activity, but can occur anywhere that dumping or spraying of contaminated oils, soil, water, or septic waste has occurred. The latter is especially troublesome, since much of that activity is illegal and may have occurred decades in the past (instances where few if any records would have been maintained). Soil testing in advance of fieldwork may be the only safe method of complying with OSHA.

Elemental lead is a heavy, soft, malleable, bluish metal. It generally occurs in nature in the form of ores, and was recovered as a by-product of smelting silver. Lead has been mined, smelted, and compounded for thousands of years. Lead compounds, such as white lead and lead chromate, were widely used as pigments in paint and are also commonly used in varnishes and primers. Most of the buildings constructed before 1980 contain some lead-based paint. Lead has also been used historically in many aspects of life. It was used to line vessels that stored water and wine, in utensils, and, in combined form, as a glaze on pottery. In addition, lead has been used in building construction, especially roofing, cornices, electrical conduits, and water and sewer pipes. Other metals of concern include mercury, arsenic, cadmium, silver, selenium, barium, chromium, zinc, nickel, and copper.

Lead typically enters the body through inhalation or ingestion. Once in the body, lead is distributed via the bloodstream to red blood cells, soft tissue, and bone. The most common symptom of acute lead poisoning is colicky abdominal pain and constipation. Chronic lead poisoning may result after lead has accumulated in the body over time, mostly in the bone.

CRM professionals involved with construction, demolition, preservation, painted toys, objects or pottery, lead crystal, contaminated soil, or other objects that potentially contain lead may unknowingly be exposed to lead and other metals. Major sources of lead and other metals include:

- lead-based paint
- urban soil and dust (depositions from paint, gasoline, and industrial sources)—specific attention should be paid when performing activities that increase dust and exposure such as during sieving
- drinking water from lead solder, brass fittings and fixtures, and service lines
- historic period objects made with or containing lead constituents or painted with lead-based paint

CRM professionals should become aware of and reduce the potential exposure to lead and other metals when performing various tasks. Even more importantly, care should be taken to change work clothes and reduce the potential for bringing lead home. Lead exposure poses serious health problems for children, babies, and fetuses.

4.7 PESTICIDES/HERBICIDES

Pesticides embrace a multitude of formulations to control various pests including insecticides (insects), fungicides (fungi), herbicides (weed and plant defoliants), rodenticide (rodents), arachnicides (spiders), and nematocides (worms) for both agricultural and nonagricultural purposes. Damage to the health of individuals, as with any toxic material, will depend on the toxicity of the compounds, dose, and duration of exposure, concentration, and individual sensitivity.

Nonagricultural uses can consist of applications in homes, lawns, buildings, greenhouses, gardens and parks, including historic places, factories, along railroads and fence lines, and power transmission or pipeline right-of-ways, or any other location where pests or plant growth is controlled or desired. Agricultural applications occur at farms, orchards, barns, fields and other locations. Pesticides can be applied by spraying, dusting, baiting, drenching, dipping, painting and injection into subsurface soil areas.

Potential exposure of CRM professionals to pesticides occurs when work is performed at or nearby any of the locations mentioned above and especially if work is being performed when or just after active application. Field survey crews working in these areas are at increased risk to exposure to pesticides.

Both pesticides and herbicides are very dangerous, especially after application in the field. There are volumes of OSHA handbooks discussing farmworker safety in regard to pesticide and herbicide exposure. Down-wind exposure to these agents is also a serious concern. Commercial fungicides also can be included in this category, and are covered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1972. The U.S. Department of Agriculture is also a source for a number of useful worker safety requirements in this area.

The most common pesticides include:

- Inorganic Arsenicals such as arsenic, lead, and cryolite compounds;
- Organochlorine Insecticides or Chlorinated hydrocarbon compounds (DDT, benzene hexachloride, lindane, dieldrin, endrin, aldrin, chlordane, isodrin, toxophene, and other similar compounds). These compounds are all nonpolar substances and thus are soluble in lipids and organic solvents, have a tendency to penetrate cell membranes and to be stored in the body fat. They do not break down readily in the environment;
- Organo-phosphates compounds (parathion, malathion, azodrin, diazinon, TEPP, and phosdrin). Some of these compounds are highly toxic;

- Carbamate compounds;
- Nitrophenolic Herbicides are highly toxic to humans and animals;
- Chlorophenoxy Herbicides are irritating to skin, eyes, and respiratory and gastrointestinal linings;
- Organomercurials are organic mercury compounds that are used as fungicides for seed, bulbs, and corn treatment.

Pesticides affect the skin, eyes, and the nervous, reproductive, hepatic, renal, hematopoietic, and cardiovascular systems. The following lists specific chemical and physical factors involved in the routes of exposure to pesticide dusts, vapors, mists, and gases:

- inhalation exposure
- dermal exposure and absorption through the skin
- ingestion and gastrointestinal absorption
- exposure through the eyes

4.8 EXPOSURE TO DUST, PARTICULATES, VAPORS, GASES

CRM professionals perform numerous tasks that increase their exposure to dust, particulates, vapors, and gases. The degree to which these pose potential exposure to hazardous chemicals will depend on the nature of the task. Cultural resources activities conducted during hazardous waste site operations or within or near industrial operations will most likely present situations of increased potential exposure to hazardous dusts, particulates, vapors, and gases. As noted in other sections, activities conducted near agricultural areas, locations that once contained historic period industrial activities, and construction sites can also have associated exposure risks. Exposure to hazardous dusts, particulates, vapors, and gases can also occur in laboratory environments.

Some of the more common cultural resources activities that may involve exposure to dusts, particulates, vapors, and gases are:

- trenching and excavating
- screening
- artifact cleaning and curation
- historic preservation of structures
- construction and demolition
- pedestrian surveys near active industrial/agricultural activities.

Many hazardous operations can be detected by visual observations. The most dusty operations can easily be observed, however, this does not necessarily mean that they are the most hazardous. Dust particles that cannot be seen by the unaided eye are the most

potentially hazardous because they are of respirable size. Likewise, the presence of many vapors and gases can be detected by the sense of smell. However, some hazardous compounds have no odor or can only be smelled at concentrations above exposure limits, or interfere with the sense of smell at relatively high levels. Prior to working in hazardous atmospheres, CRM personnel should review site-specific safety information, such as MSDSs or published tables, which provide odor threshold limits in air in comparison to exposure limits. Monitoring exposure to dusts, particulates, vapors, and gases is typically performed using real- or time integrated monitoring devices specific to the compounds and form of concern.

Exposure to particulates can include all particles, solid or liquid, that are suspended in air and may be inhaled. The three main types of particles are dusts, mists, and fumes. **Airborne dust** generally have irregular shapes, consist of clumps or aggregates of smaller particles adhering together, and are caused during crushing, grinding, or attrition of materials or by dispersion into the air of fine powder from a source material or previously settled dust. A **mist** is formed from a material that is liquid at room temperature and is rendered airborne by bubbling, boiling, spraying, splashing, or otherwise agitating a liquid or through condensation. A **fume** is formed by a material that is solid at room temperature and commonly is the airborne solid particles formed in the air above molten metal by the vaporization of metal or oxidation. The most important single parameter in determining potential exposure, subsequent monitoring, and predicting the behavior of airborne particles, other than the chemical itself, is particle size. Particles of respirable size will be of most concern.

A substance is considered to be a **gas** if this is its normal physical state at room temperature and atmospheric pressure. It is considered a **vapor** if, under present environmental conditions, a conversion of its liquid or solid form to the gaseous state results from its vapor pressure affecting its volatilization.

4.9 IONIZING RADIATION SAFETY

Radiation is energy in the form of waves or particles given off by unstable (radioactive) atoms. Radioactive material is any material containing atoms that emit radiation; radioactive contamination is radioactive material in an unwanted place. Ionizing radiation is radiation that has enough energy to ionize (remove or add electrons to neutral atoms) an atom and is derived from decaying radioactive materials or man-made devices. The four basic types of ionizing radiation with which CRM professionals have the potential to come into contact are:

- **alpha particles** - deposit a large amount of energy in a short distance of travel. This limits their penetrating ability to very short distances. The range in air is about one to two inches. Most alpha particles are stopped by a few centimeters of air, a sheet of paper, or the dead layer (outer layer) of skin. The main concern of exposure to alpha particles is associated with inhalation or ingestion (internal radiation exposure) since

it is in close contact with body tissue and can deposit large amounts of energy in a small volume of delicate body tissue.

- **beta particles** - emitted from the nucleus of an atom, these particles have a small mass and are negatively charged. Because it is negatively charged, the beta particle has a limited penetrating ability and a range of about 10 feet in air. Most beta particles are stopped by plastic, glass, metal foil, rubber mating, or safety glasses. Ingested or inhaled, beta particles can be an internal hazard due to their short range. External exposure is potentially hazardous to the skin and eyes.

- **gamma rays** - are very similar to x-ray radiation in that it is an electromagnetic wave or photon and has no electrical charge. Because gamma/x-ray radiation has no charge and no mass, it has a very high penetrating power and can easily travel several hundred feet in air. Gamma radiation can be stopped by very dense materials such as concrete, lead, or steel and exposure can result in radiation exposure to the whole body creating both an internal and external hazards.

- **neutron particles** - have no electrical charge and consist of neutrons that are ejected from the nucleus of an atom. Neutron particles have a relatively high penetrating ability, are difficult to stop, and can easily travel several hundred feet in air. Neutron radiation is best stopped by material that contains high hydrogen content, such as water or plastic. Neutrons present whole body hazards due to their high penetrating ability.

Non-ionizing radiation is radiation that doesn't have sufficient energy to ionize an atom and includes ultraviolet rays, microwaves, and visible light.

We live in a radioactive world and most of the working public is exposed to more ionizing radiation from natural background sources than from our jobs. The four major sources of natural radiation are:

- cosmic radiation from the sun and outer space;
- sources in the earth's crust (also referred to as terrestrial radiation) such as those found in the ground, rocks, building material, and drinking water supplies (radioactive elements radium, uranium, and thorium);
- sources in the human body (also referred to as internal radiation) such as Potassium-40, which is an important part of the diet and found in such foods as bananas and orange juice;
- radon which comes from the radioactive decay of naturally-occurring radium in soil and rock.

The difference between man-made sources of radiation and naturally-occurring sources is the place from which the radiation originates. Major sources of man-made radiation include:

- medical radiation such as those used in diagnosis and therapy and from x-rays;
- atmospheric testing of nuclear weapons;
- consumer products such as TV's, older luminous dial watches, some smoke detectors, pottery and pottery glazes;
- industrial uses including radiography, tracers, etc.;
- nuclear energy development.

In order to minimize the potential biological risks associated with radiation, dose limits and guidelines have been established. CRM professionals typically should not be involved with work activities that involve occupational exposure to ionizing radiation unless they are working on waste or industrial sites that have radioactive contamination. Operations conducted at such locations should be performed under the guidance of a Radiation Safety Program which is managed by a radiation safety professional and based on sound radiation principles directed at keeping occupational doses to As Low As Reasonably Achievable (ALARA). CRM professionals also should be aware, however, that certain artifacts can have low levels of associated radioactive contamination. Examples include certain pottery and glazes.

5.0 SITE-SPECIFIC HEALTH AND SAFETY PLANS

Safety plans for cultural resources activities typically are developed as either:

- **Accident prevention plans (APP)** for activities where exposure to hazardous agents (chemicals, radioactive compounds, biological agents) is minimal but physical hazards exist; or

- **Site Specific Health and Safety Plan (HSP)** for activities conducted at hazardous waste site operations in accordance with 29 CFR 1910.120.

Both types of plans should contain safety-related background information and detail specific procedures necessary to maintain health and safety. Other specific safety plans can include Underwater Dive Plans and Laboratory Safety Plans. Safety plans should address the safety and health hazards of each phase of project activity and the procedures for their control.

Some or all of the following elements should be addressed in safety plans.

- Site/Task description summary and purpose/objective of activities.

- Description of the known hazards and an evaluation of the risks associated with the site and each activity conducted (risk and/or hazard analysis).

- Lists personnel responsibilities including minimally the project manager, site safety manager, and site manager who are responsible for the safety of employees and the general public. A site health and safety person should be designated for all activities. This individual should be given the authority to terminate activities, if warranted, due to safety concerns. The responsibilities of the site safety manager are:

  - implement the health and safety program or project-specific health and safety plan and take all reasonable precautions with regard to health and safety
  - take corrective actions relative to unsafe or potentially unsafe working conditions
  - stop work in emergencies
  - conduct project-specific safety briefings that may include project kick-off and daily meetings thereafter

- Routine and project-specific training requirements.

- Levels of personnel protection requirements for each task.

- Frequency and type of environmental and personnel monitoring requirements (i.e., real-time air, radiological, biological) specific to employees and/or tasks and equipment used.

- Delineation of specific work areas (i.e., contamination zones, clean zones, biological areas, radioactive areas, decontamination areas, etc.).

- Decontamination procedures for personnel and equipment.

- Medical surveillance requirements.

- Access control measures.

- Emergency response numbers, procedures, and plan including any specific medical care for injuries or toxicological problems (i.e., specific chemical treatment, decompression sickness).

- Site/task specific requirements (i.e., confined space entry procedures, trench excavation requirements)

- Procedures for protecting workers from weather-related safety concerns.

- Spill containment program.

HSPs or APPs should be developed and/or reviewed and approved by a health and safety professional(s). For many cultural resources projects, plans will be required to be reviewed by government agencies (federal, state, or local) or prime contractor safety specialists.

Background information used to provide the basis for the development of the plan may include:

- site location, name and description or task/operation description;
- chemical and physical hazards;
- chemical and physical properties;
- prevailing weather conditions and forecast;
- surrounding population and land use;
- ecologically and cultural resources sensitive areas;
- description and durations of tasks to be performed;
- accessibility for emergency purposes including distance to nearest emergency care facility;
- topographic and hydrologic information.

The plan should be tailored to the conditions imposed by the site or task. As additional information becomes available, the plan should be modified as necessary to protect

against the hazards that occur. This can be initiated during daily or weekly safety meetings.

Safety plans can vary greatly based on the type of work and hazards. Simple safety summaries in checklist format may be acceptable and preferable for certain functions, while more in-depth plans may be required for others such as those required for hazardous waste site work. An example of a simple plan is provided in Appendix A.

The following is a suggested format which provides the necessary topics to be covered for plans required for hazardous waste site operations. These topics can be covered in any order that logically fits the individuals who will use the plan. **If the plan cannot be effectively used by personnel, it is not useful.**

SUGGESTED FORMAT FOR SAFETY PLAN FOR HAZARDOUS WASTE SITE OPERATIONS

- **Purpose and Objectives** - The plan should include a statement delineating the purpose and objectives of the plan including the scope of work. The plan should describe the regulatory applicability and its intent for the exclusive use of the firm, company, or specific CRM individuals.

- **Site/Task Description and Background** - The plan should include a brief description of the site or specific tasks (for task-specific plans), including site history, unusual features that may effect health and safety (i.e., power lines, buried utilities, buildings, tanks, industrial history, etc.). The plan should include a brief history which describes information such as operational history, previous investigations and data, previous complaints or health and safety issues. The plan should also include a brief overview of chemical, physical, or biological hazards that will be covered in-depth later in the plan, such as indiscriminate dumping, areas where industrial operations occurred, presence of tanks or drums, etc.

- **Work/Task Hazard Evaluation/Analysis** - The work hazard evaluation and analysis includes all known or suspected physical, chemical, biological, or radiological hazards. This should be continually updated as the project progresses and as sampling or monitoring data becomes available. Hazards can include chemical hazards of concern including regulatory-based permissible exposure limits; physical hazards such as cold and heat stress, noise hazards, underground utilities, heavy equipment, confined space, traffic or boat safety, hand tool safety, lockout/tagout; biological hazards associated with pathogens, snakes, plants, etc. This section should include an overall hazard rating by task or specific location and may include describing the site or tasks as extremely, high, moderate, or low hazard areas/activities.

- **Field Activities/Tasks** - The plan should include a brief description of the proposed activities and specific techniques to be used (shovel tests, trenching, drilling, confined space entry, etc.).

- **Personal Protective and Monitoring Equipment** - Personal protective equipment and clothing should be listed for each task including standard levels of protection and modifications. Clothing limitations and duration of tasks may also be described. A description by task should be provided which describes the program and equipment used to monitor hazards. This may include all real-time and time-integrated air monitoring and other environmental media sampling used to indicate chemical, radiological or biological hazards as well as explosive and oxygen-deficient atmospheres. Action levels should be established which provide a criteria for altering the prescribed personnel protection, administrative, or engineering controls. Dust control methods, for example, which are prevalent at archaeological surveys, should be presented. Action levels established by the EPA can be used as a basic guide.

- **Site Organization and Decontamination** - Work areas should be designated and may include: exclusion zone (contaminated area where work takes place and hazard potential is greatest), contamination reduction zone (a buffer area between a hazard area and clean area where decontamination takes place), and support zone (clean area where support functions occur and supplies are stored). The size and sophistication of these zones will vary based on the complexity of the project and hazards. Zone boundaries and access areas should be clearly established to prevent unauthorized/unsafe entry or exit to hazard areas. Decontamination procedures for personnel, survey and sampling equipment, and heavy equipment should be described. Procedures for control and disposal of investigative-derived waste (i.e., disposable clothing, waste water, sieved soil, etc., should be described.

- **Personnel and Responsibilities** - The plan should identify the key personnel responsible for safety and management and may list personnel assigned to various operations. Minimally, the plan should identify the site manager, site safety coordinator, and office/project manager.

- **Emergency Contacts and Procedures** - The plan should discuss actions taken to address occurrences that require immediate actions to prevent additional problems or harm to workers, the public, property, or the environment. Unpredictable events may occur such as fire, chemical exposure, or physical injury and the plan should contain contingencies for managing them. The plan should minimally contain the following:

    - a list of names and emergency function of personnel responsible for emergency actions;
    - a list of emergency service organizations and phone numbers. The numbers should be checked to ensure they are correct, and should be listed in such a way that they can be posted prominently at the work location for access by all personnel;
    - address and define procedures for site evacuation including clear audible warning signals and internal/external communication plans.

- first aid and emergency equipment;
- location and direction to nearest emergency medical care facility (These should include written directions and an annotated map.);
- procedures to address weather-related conditions, including heat and cold stress, wind, rain/snow, lightning, etc., as they impact personnel safety;
- blood-borne pathogen/universal precautions

- **General Safe Work Practices** - A list of safe work practices specific to the project or task and to the industry in general should be presented. These may include general sanitation, machete safety, hiking safety, etc.).

- **Medical Monitoring Requirements** - The plan should address medical monitoring requirements for personnel and tasks.

- **Training and Briefing Topics** - The plan should list any specific training requirements and should require safety briefings that may include at project start-up, daily, weekly, etc.

- **Plan Signoff and Acknowledgment of Acceptance** - It is essential that all personnel receive a copy of the plan, read and understand it, and agree to the plan's provisions. The plan should include a sign-off sheet to document acknowledgment and acceptance of the plan. Typically the plan is distributed to personnel prior to commencing work for their review. The site safety manager often reviews the plan and coordinates signoff and record keeping.

Safety plans can range from very simple to very complex. Plans for work at high-hazard waste sites or for U.S. Army Corps of Engineers (USACE) projects typically require more sophistication and detail. Plans for USACE projects should be developed using the requirements set forth in the most current version of the *USACE Safety and Health Requirements Manual*, EM 385-1-1. An example of a simple/generic HSP in form format is included in Appendix A.

6.0 HAZARD COMMUNICATION

The OSHA Hazard Communication Standard, often referred to as the HAZCOM standard is contained in 29 CFR1910.1200 and 29 CFR1926.59 (See Appendix B). The standard was developed to provide workers with the ability to obtain health and safety information about the hazardous chemicals to which they may be occupationally exposed. The HAZCOM standard is also referred to as the Worker Right to Know Law. This law identifies the requirements for employers to provide health and safety information for employees. These requirements include:

- maintaining a written Hazard Communication program for the workplace,
- proper labeling of hazardous and toxic chemicals,
- maintaining material safety data sheets (MSDSs) for all chemicals at the job site, and
- training including attendance at basic site or job specific HAZCOM training.

Compliance with the standard at cultural resources worksites and offices may include adherence to the following:

- Each location that stores or uses hazardous chemicals should have a HAZCOM Program which meets or exceeds the requirements of OSHA;
- All containers of hazardous chemicals must be appropriately labeled or tagged to identify the hazard and provide information on effects and appropriate protective measures;
- Labels, tags, or signs must be affixed and visible at all times while a hazard is present and removed promptly when the hazard no longer exists;
- Written information (MSDSs) on hazardous chemicals in the workplace must be available to employees working with the substance;
- Any contractor or subcontractor employees working in offices, laboratories or at construction, excavations or other sites, such as museums and curation areas, should have MSDSs for any hazardous chemical in use. A central file of MSDSs should be maintained.

All CRM firms should maintain a current inventory of hazardous chemicals that are used at or are stored at office, laboratory or field locations. This inventory should also include any consumer products that are covered by the HAZCOM Standard by the following criteria:

- If the consumer product is used in a manner such that CRM personnel are not likely to receive greater exposure to the product in the course of

normal workplace usage than they would using the product outside of the workplace, then the product need not be included;
- If CRM personnel are likely to receive greater exposure to the product in normal workplace usage than they would in using the product outside of the workplace, than the product would be included in the chemical inventory;
- If in doubt, include the product.

The purpose of labels for hazardous chemicals or products containing them is to warn about potential danger or significant risk. Labels were not intended to be either the sole or the most complete source of information regarding the nature or the identity of hazardous chemicals in the workplace. OSHA's stated purpose for labels is that they serve as an immediate warning and as a reminder that more detailed information is provided in other formats (e.g., posters, MSDSs, notices). The identity of the chemical on the label must be keyed to the MSDS for that chemical that will contain more extensive information.

6.1 MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheets (MSDSs) are designed to provide workers with information on the hazards of chemicals, and provide users important information about a hazardous material, its manufacturer, physical and chemical hazards, and appropriate safety precautions. The OSHA HAZCOM Standard (29CFR1910.11200) identifies required sections of the MSDS sheet and discusses the information that must be provided.

Required for all chemicals at a job site, MSDSs must be available to workers laboring at or near the project location. Subcontractors are required to submit an MSDS for any chemical to be used on site. All MSDSs should be current (not more than three years old.)

CRM supervisors should review applicable MSDSs with workers and subcontractors working in their area to ensure that they are aware of any potential hazards involved in the work to be performed.

The following minimum information should be on a MSDS:

- the identity used on the label (the chemical and common names);
- if the substance is a mixture, all ingredients which are health hazards and in a concentration of 1% or more; for carcinogens, if the concentration is 0.1% or more;
- physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash points);
- the physical hazards of the hazardous chemical;
- the health hazards of the hazardous chemical;
- the primary routes of entry;

- the OSHA permissible exposure level, American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV), and any other exposure limit used or recommended by the manufacturer;
- whether the chemical is a carcinogen (listed in the National Toxicology Program [NTP], or the International Agency for Research on Cancer [IARC], or by OSHA);
- precautions for safe handling and use;
- recommended control measures (engineering, work practices, personnel protective equipment);
- emergency/first aid procedures;
- date of preparation
- name, address, and telephone number of the chemical manufacturer.

In general, a program and training for CRM professionals applies to any personnel who work with hazardous chemicals, such as those used in laboratory operations, technical illustrations, and in some equipment decontamination processes. Consumer products, such as correction fluids (white-out) and household-type cleaning products (glass cleaner, cleansers, etc.), may also be covered. Training should include:

- summary of the standard and written program;
- chemical and physical properties of hazardous materials (e.g., flash point, reactivity) and methods that can be used to detect the presence or release of chemicals;
- physical hazards of chemicals (e.g., potential for fire, explosion, etc.);
- health hazards, including signs and symptoms of exposure, associated with exposure to chemicals and any medical condition known to be aggravated by exposure to the chemical; procedures to protect against hazards (e.g., personal protective equipment required, proper use, and maintenance; work practices or methods ro assure proper use and handling of chemicals; and procedures for emergency response);
- where MSDSs are located, how to read and interpret the information on both labels and MSDSs, and how employees may obtain additional hazard information.

7.0 MEDICAL SURVEILLANCE REQUIREMENTS

The need for medical surveillance for CRM professionals will depend greatly on the nature of activities typically conducted. Medical surveillance can be required on a job-specific basis or it may be instituted on an ongoing annual basis if warranted by the type of contracts or work performed. The intent of a medical monitoring program is to monitor the health of individuals as it relates to occupational exposures through the use of medical examinations and diagnostic testing. Medical monitoring will most likely be required for cultural resources activities at hazardous waste sites as specified in 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response). It also may be required for cultural resources activities which involve the various substance-specific standards in 29 CFR, Subpart Z, Sections 1910.1001 through 1910.1050 or where respiratory protection or noise protection is required (1910.34 and 1910.95 respectively.).

The overall goal of a Medical Surveillance Program is to protect the health of workers. Objectives of a medical surveillance program may include:

- certification that individuals are medically cleared to work on certain projects such as hazardous waste projects as required by OSHA (29 CFR 1910.120) and provide medical clearance status for each employed based on medical exam results;
- establishment of baseline conditions against which any future changes in health or physical well being can be evaluated;
- conducting ongoing analyses of work environments relative to potential exposures;
- development of medical monitoring protocols based on potential exposures;
- identification of any underlying illnesses or conditions which might be aggravated by certain exposures or job activities;
- identification of local medical providers for the provision of physical exams and laboratory testing;
- evaluation of all exam results from an Occupational/Exposure perspective;
- recognition of any abnormalities, toxic reactions or other changes at the earliest opportunity so that corrective actions can be taken;
- manage medical records according to regulatory and medical/legal requirements.

Typical medical surveillance programs include the following:

- ongoing analyses of work environments to determine the need for or changes to the program.
- medical monitoring protocols including requirements for:
  - examining physicians' qualifications,

  - medical facilities/clinics' medical requirements,
  - accessibility to the employees,
  - quality and efficiency of the physical exam according to pre-set specifications.
- all physical exam and testing results should be completely reviewed by a qualified individual to evaluate:
  - occupationally related illness/injury,
  - quality, accuracy, and completeness of the exam data;
  - accuracy of testing data from a regulatory compliance perspective (e.g. spirometry and audiometric data);
  - need for medical follow-up;
  - determination of medical clearance including a summary profile provided by the medical personnel indicating the presence or absence of work restrictions, and the employees ability to wear a respirator. If follow-up testing is recommended, medical personnel should contact the employee directly.
- original medical exam results should be retained by the examining physician in compliance with 29 CFR 1910.120 and 1910.20. A complete copy of the results should be sent by the examining physician to the company person responsible and to the employee (upon request). Copies of exam results should be retained for purposes of historical and/or epidemiological review.

Medical monitoring should be conducted for all employees whose work activities may include:

- using respiratory protection
- contact with hazardous materials
- contact with body fluids
- contact with microbial/viral/biological hazards
- high noise areas
- diving
- asbestos
- radiological hazard.

Prior to examinations, the examining physicians should receive:

- a copy of regulatory requirements specifically related to medical surveillance;
- descriptions of the worker's job duties relative to exposures;
- worker's anticipated exposure levels; and
- description of personal protective equipment used, including respirator use.

If there are anomalies in the exam results, the medical personnel should contact the worker directly.

Frequency of exams can include those listed below.

- Pre-placement/Baseline exams (conducted prior to beginning site work activities)
- Annual (conducted within 12 months of the baseline exam).
- Project Specific (conducted at the beginning and end of a specific project or task).
- Exposure Related Medical Evaluation (following an acute exposure to toxic or hazardous substances and as soon as possible after the development of signs/symptoms that are presumed to be work related).
- Termination/closeout exam (conducted when worker leaves employment, at a specific job ending or permanent reassignment).

Medical records should be managed according to 29 CFR 1910.20. Medical records will be maintained for the duration of employment plus 30 years. Medical records management typically consists of the following:

- Original record is retained and stored by the examining physician/clinic.
- One copy of the complete record for purposes of historical and epidemiological review.
- Release of medical information should occur only with written permission of the worker or worker's representative. All medical information must be maintained as confidential.

Cultural resources firms or individuals should use the help of professionals including a licensed physician to develop an effective occupational medical monitoring program. Typical Items Included in Medical Monitoring programs include:

- review of medical and occupational history;
- general physical exam including height, weight, temperature, pulse, respiration, and blood pressure;
- head, nose, and throat examination;
- visual acuity examination;
- otoscopic examination (ears) and audiometric testing consistent with OSHA 1910.15;
- chest (heart and lungs);
- peripheral vascular system, nervous system;
- abdomen (liver, spleen, kidney);
- skin;
- musculoskeletal system, genitourinary system;
- pelvic, breast, and rectal (guaiac) examination for women

- testicular and rectal (guaiac) examination for men;
- blood tests, blood count, and blood biochemical profile such as a complete CBC and blood chemistries:
- urinalysis;
- pulmonary function examination (FVC, FEV1, FEV1/FVC);
- electrocardiogram (EKG);
- other optional tests such as stress tests, chest X-ray, vaccination updates.

TYPICAL SUMMARY PROFILE

Employee Name: _____ Exam Date: _____

Company: _____ Date: _____

Position: _____ Social Security Number: _____

Work Assignment: ( ) Hazardous Waste Site
( ) Respiratory Protection
( ) Other _____

The Examining Physician has conducted a medical monitoring examination consistent with the requirements of 29 CFR 1910.120 and 1910.134 and the medical information regarding the aforementioned employee, and work assignment. The following status has been established:

1. ( ) Medically qualified to perform the stated work assignment.

2. ( ) Medical condition exists which will not interfere with job responsibilities. The individual has been advised of this finding.

3. ( ) The examination disclosed a medical abnormality which may require special consideration by the company.

4. ( ) Deferred pending further evaluation.

5. ( ) Medically qualified to use respiratory protective devices
( ) not qualified to use a respirator

6. ( ) No Restrictions
( ) Restrictions: *summarize below or attach*

_____

Printed Name of Examining Physician Signature of Examining Physician

_____

Printed Name of Reviewing Physician Signature of Reviewing Physician

Name and Address of the medical facility: _____

_____

_____

8.0 PERSONAL PROTECTIVE EQUIPMENT

CRM professionals perform field surveys and other tasks that may involve working with or in close proximity to physically, biologically or chemically hazardous or toxic environments requiring the use of Personal Protective Equipment (PPE). PPE is often underutilized, or worse, not thought of when planning and performing various cultural resources and archaeological surveys and investigations. Certain tasks performed by CRM professionals have a high potential to put them at risk of exposure to chemicals and biological agents either via the respiratory or skin route or both. One obvious example is during shovel testing and trenching operations when personnel are exposed to dust, vapor, and particulates via both the respiratory and skin pathways, especially when sieving is occurring, excavations are entered, or historic buildings are undergoing renovation. Other typical examples of potential exposure include during artifact cleaning or curation operations, underwater surveys conducted in heavily polluted environments (i.e., sewer outfalls, near waste chemical process outfalls), or work activities that bring people into contact with disease-infected rodents and dust/particle-infected rodent saliva or excreta.

The purpose of the use of personal protective clothing and equipment by CRM professionals is to shield or isolate them from the chemical, physical, and biological hazards that they may encounter during various work activities.

PPE is to be utilized when the use of engineering controls (i.e., shielding) or administrative controls (i.e., time limits, location constraints) have been determined to be exhausted or are unsuitable for providing protection from the hazard for a particular situation. PPE provides a barrier between the hazard and the individual. The effectiveness of the material to provide protection is based upon its resistance to penetration, degradation, and permeation. Therefore, proper selection of any protecting equipment requires understanding the chemical degradation of protective material, permeation rate of a material, and the penetration potential of a specific chemical or agent.

Under some circumstances, the use of PPE is required by OSHA regulations in 29 CFR Part 1910 and reinforced by EPA regulations and ANSI standards and guidelines.

No single combination of PPE and clothing is capable of protecting against all hazards and PPE must be used in conjunction with other protective methods. The use of PPE can in itself create significant worker hazards, such as heat stress, physical and psychological stress, and impaired vision, mobility and communication. For any given situation, equipment and clothing must be selected to provide an adequate level of protection. Over-protection a well as under-protection can be hazardous and should be avoided.

The use of PPE, such as hard hats, work gloves, safety glasses, hearing protection, etc., should be common practice at cultural resources projects associated with construction sites and other industrial settings. CRM professionals working at hazardous waste sites will need to follow the requirements of a site safety plan which will specify PPE requirements. CRM professionals should wear protective clothing when project

environments or site activities involve known or suspected atmospheric activities; or when direct contact with skin-affecting substances may occur.

CRM professionals involved with hazardous waste operations must receive OSHA 29 1910.120 training. When working at hazardous waste sites, PPE is typically divided into four general categories according to the degree of protection afforded:

- **Level A:** Should be worn when the highest level of respiratory, skin, and eye protection is needed.
- **Level B:** Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection.
- **Level C:** Should be worn when the criteria for using air-purifying respirators are met, and a lesser level of skin protection is needed.
- **Level D:** Should be worn only as a work uniform and not on a site with respiratory or skin hazards. *It provides no protection against chemical* hazards.

Modifications can be made to these levels of protection to meet the needs of site-specific or task-specific demands.

The criteria used in establishing action levels and selecting PPE includes:

- the type, measured or projected concentration of the chemical substances, its toxicity, and the evaluated degree of hazard;
- potential for exposure to substances in the air, liquid splashes or other direct contact with hazardous materials;
- knowledge of the hazards present including the toxic effects, physical/chemical properties, routes of exposure.

The following are generally accepted guidelines for the selection of PPE. These guidelines were established and used by EPA, and are listed as a non-mandatory appendix to 29 CFR 1910.120. It should be understood that these are only guidelines and not hard and fast rules; they are best used in situations where very little is known about the site outside of initial survey readings. In most instances, the site-specific health and safety plan will provide sufficient guidance regarding PPE selection.

The following description of levels of protection is based on EPA guidance.

8.1 LEVEL A PROTECTION

Work requiring the use of Level A protection is most likely outside the scope of most cultural resources projects. The information is provided for informational purposes. PPE for this level of protection includes:

- supplied-air respirator approved by the Mine Safety and Health Administration (MSHA) and NIOSH typically positive pressure-demand, self contained breathing apparatus (SCBA),
- fully encapsulating chemically-resistant suit,
- chemically resistant gloves,
- chemically resistant boots,
- additional clothing and equipment as necessary such as communication devices, hard hats, cooling vests, etc.

Criteria for selection or conditions that require Level A protection include:

- A chemical substance has been identified that requires the highest level of protection for skin, eyes and respiratory system. This may be based upon a measured or potential high concentration of atmospheric vapors, gases or particulates, or upon site operations and work functions that have a high potential for splashes or immersions or exposures to vapors, gases or particulates of materials highly toxic to the skin;
- Substances with a high degree of hazard to the skin are known or suspected to be present and skin contact is possible;
- Operations are conducted in confined, poorly ventilated areas and the absence of substances requiring Level A protection has not been established;
- Direct readings on field flame ionization detectors (FID), photo ionization detectors (PID) and similar instruments indicate high levels of unidentified vapors and gases into the air;
- Visible air emissions from leaking containers, such as drums, tanks and railroad or highway tank cars, or as smoke from chemical fires and other sources indicate a high potential for concentrations of substances that could be extreme respiratory or skin hazards;
- Substances whose concentrations are not quantifiable with field instruments and highly toxic through skin absorption are known or suspected to be present on site; and
- Unstable conditions which could result in a sudden or unexpected release of significant amounts of hazardous material which pose a skin and respiratory exposure.

8.2 LEVEL B PROTECTION

Level B affords the highest level of respiratory protection but a lesser level of skin protection, and is the minimum level for initial site entries unless hazards have been further characterized. PPE for this level of protection includes:

- supplied-air respirator,
- chemically resistant clothing consisting of
  - overalls and long sleeve jacket, or
  - hooded one-piece chemical splash suit, or
  - disposable chemical resistant, one piece suits, and
  - inner and outer chemical resistant gloves,
- chemically resistant boots with steel toe and shank,
- hard hat,
- other optional equipment includes: 2-way, intrinsically safe radios; long cotton underwear; coveralls; outer-disposable, chemically resistant boot covers.

Meeting any of the following criteria warrants the use of Level B protection. CRM professionals will most likely not use this level of protection unless work is being performed at hazardous waste sites. A high level of training is required Criteria for selecting Level B includes:

- The type and atmospheric concentration of toxic substances has been identified and requires a high level of respiratory protection, but less skin protection than Level A. This would be an atmosphere with Immediately Dangerous to Life and Health (IDLH) concentrations, but the substance or concentration in the air does not represent a severe skin hazard, or the atmosphere does not meet selection criteria permitting the use of air-purifying respirators;
- The atmosphere contains less than 19.5 percent oxygen;
- Atmospheric concentrations of unidentified vapors or gases are indicated by direct readings on instruments such as the FID or PID to be within the action levels prescribed in the HSP for Level B respiratory protection, but such vapors and gases are not suspected to contain high levels of chemicals toxic to the skin;
- The HSP calls for the use of supplied air respirators under current site conditions; and
- It is highly unlikely that the work being done will generate high concentrations of vapors, gases, particulates, or splashes or material that could affect the skin of personnel wearing Level B protection.

When selecting Level B protection, it is important to considered that Level B does not afford the maximum skin protection as does a fully encapsulating suit (Level A) since Level

B chemical-resistant clothing is not considered gas, vapor or particulate tight. However, a good quality, hooded, chemical-resistant, one-piece garment, with tight taped wrist/glove, ankle/bootie, hood/collar joints and zipper seams does provide a reasonable degree of protection against splashes at lower air concentrations of hazardous chemicals. In most instances, Level B will generally represent the highest level of protection that CRM hazardous material workers will be allowed to utilize.

The chemical-resistant clothing required in Level B is available in a wide variety of styles, materials, construction detail, and permeability. One- or two-piece garments are available with or without hoods and attached overboots. Disposable suits with a variety of fabrics and design characteristics are also available. These factors and other selection criteria all affect the degree of protection afforded; and a health and safety professional should select the most effective chemical-resistant clothing based in known or anticipated hazards and job function.

Level B equipment does provide a high level of protection to the respiratory tract. If SCBA is required for respiratory protection, selecting chemical-resistant clothing (Level B) rather than a fully-encapsulating suit (Level A) will generally be based on needing less protection against known or anticipated substances affecting the skin. Level B protection is selected by:

- comparing concentrations of known or identified substances in air with skin toxicity data;
- determining the presence of substances that are destructive to or readily absorbed through the skin because of liquid splashes, unexpectedly high levels of gases, vapor, particulates or other means direct contact; and
- assessing the effect of the substance on small areas left unprotected by chemical-resistant clothing. A hooded garment taped to the mask with boots and gloves taped to the suit reduces the area of exposure further.

8.3 LEVEL C PROTECTION

CRM professionals may have a need to work in this level of protection at hazardous waste sites, during artifact curation or laboratory work which involves the potential exposure to known chemicals. Level C provides the same level of skin protection as Level B, but a lower level of respiratory protection. Level C protection is distinguished from Level B by the equipment used to protect the respiratory system assuming the same type of chemical-resistant clothing is used. Modified versions of Level C ensembles are frequently used by CRM workers at sites where skin hazards are not present. Typical level C includes:

- air-purifying respirator (half-face or full-face) with appropriate cartridges or canisters;
- chemical-resistant clothing (i.e., coveralls, or hooded one- or two-piece chemical splash suit, or disposable chemical-resistant coveralls);
- inner and outer chemical-resistant gloves;

- chemical-resistant boots with steel toe and shank;
- safety glasses or goggles (with half-face respirators);
- other optional equipments such as hard hat, face shield, communication devices, escape mask.

The following criteria must be met in order for the use of Level C protection:

- Oxygen concentrations are greater than 19.5 percent and less than 23.5 percent by volume;
- Measured air concentrations of identified substances will be reduced by the respirator below the PEL, TLV, or Recommended Exposure Limit (REL), and the concentration within the service limit of the cartridge;
- Atmospheric contaminant concentrations do not exceed IDLH level;
- Atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect skin areas left unprotected by chemical-resistant clothing;
- Job functions do not require self-contained breathing apparatus; and
- Continuous direct readings on monitoring instruments such as FIDs or PIDs are within the action levels prescribed in the HSP for air-purifying respirator use.

The main selection criterion for Level C is that conditions permit wearing air-purifying respirators. The air-purifying device may be either a full-face or half-face respirator (depending on action levels in the HSP) and equipped with appropriate cartridges. Cartridges must be able to remove the substances encountered. The following guidance should be used when selecting Level C protection:

A full-face, air-purifying respirator can be used only if:

- the substance has adequate warning properties;
- the individual using the respirator has passed at least a qualitative fit-test;
- the individual has medical clearance for respirator use;
- the appropriate cartridge is used and its service limit concentration is not exceeded.

A half-face respirator can be used if:

- the contaminants do not cause eye irritation;
- the action level criteria for half-face respirator use described in the HSP are met.

An air monitoring program is part of all hazardous material/waste site operations when atmospheric contamination is known or suspected. It is mandatory that the ambient air be

thoroughly monitored when personnel are wearing air-purifying respirators. Surveillance using a direct-reading instrument and/or other air sampling equipment in accordance with the HSP is required during all Level C and B operations to detect changes in air quality necessitating a higher level of respiratory or skin protection. Level C protection with an air purifying respirator will be worn routinely in an atmospheric only after the type of air is evaluated, concentrations measured and the criteria for wearing air-purifying respirators are met.

A decision to wear Level C continuously can only be made after evaluating all safety factors, which include:

- The presence of or potential for organic or inorganic vapors or gases for which cartridge is ineffective or has a short service life;
- The known or suspected presence in air substances with low TLVs, PELs, or IDLH levels;
- The presence of hazardous particulates in air;
- The errors associated with the instruments and monitoring procedures used;
- The presence of or potential for substances in air which do not elicit a response on the instrument used; and
- The potential for higher concentrations in the ambient atmosphere or in the air adjacent to specific operations.

8.4 LEVEL D PROTECTION

Level D protection is a fieldwork uniform affording no protection against skin or respiratory hazards. The following represents typical level D clothing:

- coveralls;
- work gloves;
- safety boots, leather or chemically resistant, with steel toe and shank;
- safety glasses or goggles;
- hard hat with face shield (as required)
- escape mask (as required).

Meeting any of these criteria allow use of Level D protection:

- No contaminants are present, or contaminants are present below the action levels established in the HSP for respirator use;
- Work functions preclude splashes, immersion, or potential for unexpected inhalation of any chemicals.

Level D protection can be upgraded to include skin protection (i.e., gloves) if respiratory protection is not needed. Primarily a fieldwork uniform, Level D protection can be worn only in areas where there is no possibility of contact with contamination. Most work conducted by CRM professionals will require the use of some form of Level D PPE. Some pieces of protective equipment, such as hardhats, boots, and respirators, have specific standards for manufacture and only those items meeting these standards should be used. However, there are no such standards for much of the chemical protective clothing used on field activities, for which selections must be made based upon guidance. The following requirements pertain to the more common types of standard PPE.

Eye Protection/Safety Glasses

If work is being conducted that potentially can harm the eyes, such as tasks that cause splashing or the releasing of projectiles or sufficient vapors or dusts as to cause eye irritation problems, eye protection should be worn.

Safety glasses shall meet the current ANSI Z87.1 standard. Safety glasses are used to protect eyes against large particles and projectiles, but must be used in conjunction with face shields or goggles in order to protect against splashes. Safety glasses generally do not provide protection against dusts, vapors, or mists. If lasers are used to survey a site, special protective safety glasses are required.

In general, it is not appropriate to wear contact lenses for field activities or any activity which could not be safely performed using contact lenses. Contact lenses are not to be worn in conjunction with respiratory protection, or in areas with potential for contact with eye irritants.

Hearing Protection

Ear plugs or ear muffs should be worn by personnel who are required to perform tasks around heavy machinery and impact tools where physiological damage to ears is possible. The OSHA noise standards apply and must be considered, especially in the case of long term site activities. Ear protection must comply with OSHA 29 CFR 1910.95.

Foot Protection

Foot protection, including leather work boots and rubber boots, worn during field activities should meet the specifications of ANSI Z41 and OSHA CFR 1910.136. Consideration should be given for the use of steel toe/shank boots. All field footwear should also be of leather (or synthetic leather) construction with ankle support suitable for the terrain or work encountered.

Protection against hazardous chemicals requires a boot constructed of an elastomer—neoprene, PVC, butyl rubber or some other chemical resistant material suitable to the site chemical hazards. Leather boots are not to be worn solely for protection from chemical hazards.

Hand Protection

Gloves are used to provide hand protection. Despite the absence of standards governing glove construction and materials at present, gloves must resist puncturing and tearing as well as provide the necessary chemical resistance. In many instances, particularly when protecting against concentrated source materials, gloves may have to be layered. In this case, gloves are referred to an "inner" glove and "outer" glove. Heavy leather gloves may be worn over chemical protective gloves when doing heavy work. If they become contaminated, they should be discarded because leather is difficult to decontaminate.

When selecting gloves, consider thickness and cuff length. In general, the thicker and longer the glove, the greater the protection. However, the glove should not be so thick that it interferes with the necessary dexterity.

Head Protection

The hard hat must meet ANSI Z89.1 and OSHA 29 CFR 1910.135 specifications. Hard hats are to be rated Class B for impact and electrical resistance. Manufacturers have adapted hard hats so that ear protection and faceshields may be easily attached.

PPE Training

The training portion of the PPE program should describe the user's responsibilities and explain the following, utilizing both classroom and field training when necessary. Elements of PPE training include:

- The proper use and maintenance of the selected PPE, including capabilities and limitations;
- The nature of the hazards and consequences of not using the PPE;
- The human factors influencing PPE performance;
- Heat stress issues and warning symptoms of its onset;
- Instruction in inspecting, donning, checking, fitting, and using PPE;
- The user's responsibility for decontamination, cleaning, maintenance, and repair of PPE;
- Emergency procedures and self-rescue in the event of PPE failure;
- The buddy system;
- The Site Safety Plan and the individual's responsibilities and duties in an emergency.

Other Considerations Associated with PPE

Heat and Physical Stress - The use of protective clothing increases physical stress, in particular heat stress, on the wearer. PPE can greatly reduce body ventilation and diminish its ability to regulate its temperature, which can relate to one or more heat stress-related problem even in moderate temperatures. Wearing PPE also increases the risk of

accidents because it often interferes with normal dexterity, agility, vision, and is fatiguing to wear.

9.0 TRAINING REQUIREMENTS AND RECORD KEEPING

Since CRM professionals can be engaged in a variety of potentially hazardous activities, the level of and requirements for training will depend on the nature of tasks. The highest level of training that likely will be provided to CRM professionals would occur for work associated with hazardous waste site operations. **All personnel who participate in hazardous waste site operations must have completed a training program that meets the requirements of 29 CFR 1910.120.** For the most part, CRM professionals are typically involved in activities that are not associated with hazardous waste site operations but which may contain hazards that require health and safety training either as a requirement of OSHA or because training makes good personal and business sense. Other examples of activities in which cultural resources workers should receive specific training include:

- Underwater Operations (29 CFR 1910.401 subpart T - Commercial Diving Operations as well as those contained in the *U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 85 1-1* and the U.S. Navy diving manual).
- Confined Space Entry
- Industrial, Clinical, and Academic Laboratories (29 CFR 1910.1450)
- Hazard Communications and Blood-borne Pathogen requirements
- Construction Worker Protection Programs (29 CFR 1926.20, 1926.21 and 1926.62 associated with accident prevention).

The objectives of the training program should be:

- to make workers aware of potential hazards they may encounter;
- to provide the knowledge and skills necessary to perform required work with minimal risks;
- to make employees aware of the purpose and limitations of safety equipment and how to use it effectively;
- to create a work environment whereby workers can safely avoid or escape from emergency situations; and
- to provide employees with certifications required by federal and state rules for certain tasks (e.g., for work at hazardous waste sites).

Whatever the extent of training, workers shall not engage in potentially hazardous activities until they have been trained to a level commensurate with their job function and responsibility and with the degree of anticipated hazard. Examples of training elements for specific programs are provided below.

9.1 HAZARDOUS WASTE SITE TRAINING

Personnel who work at hazardous waste operations are required to complete an initial training (typically 40- or 24-hours); an 8-hour annual refresher course in order to maintain their eligibility for participation in hazardous waste field operations; and an 8-hour supervisors training for site-management personnel. OSHA regulations contained in 29 CFR 1910.120 (e) (3) describe specific initial training requirements for hazardous waste operations field personnel. OSHA 40-hour Hazardous Waste Field Operations course typically cover the following topics:

- overview of the applicable paragraphs of 29 CFR 1910.120;
- overview of RCRA, CERCLA and SARA regulatory requirements;
- effects of chemical exposures to hazardous substances (i.e., toxicity, carcinogens, irritants, sensitizers, etc.);
- effects of biological and radiological exposures;
- fire and explosion hazards (i.e., flammable and combustible liquids, reactive materials);
- General safety hazards, including electrical hazards, powered equipment hazards, walking-working surface hazards and those hazards associated with hot and cold temperature extremes;
- confined space;
- specific safety, health and other hazards that are to be addressed at a site and in the site safety and health plan;
- use of PPE and the implementation of a PPE program;
- work practices that will minimize employee risk from site hazards;
- safe use pf engineering controls and equipment and any new relevant technology or procedure;
- content of the medical surveillance program and requirements, including the recognition of signs and symptoms of overexposure to hazardous substances;
- the contents of an effective site safety and health plan;
- use of monitoring equipment with "hands-on" experience and the implementation of the employee and site m monitoring program;
- selection and use of material handling equipment;
- methods for assessment of risk and handling of radioactive wastes;
- container sampling procedures and safeguards;
- safe preparation procedures for shipping and transport of samples/materials;
- decontamination program and procedures;
- emergency response plan and procedures;
- overview and explanation of OSHA's HAZCOM standard (29 CFR 1910.1200);
- sources of reference, additional information and efficient use of relevant manuals and hazard coding systems;
- principles of toxicology and biological monitoring.

Respiratory protection training is included in the initial 40-hour training. Topics covered typically include:

- overview of respiratory protection;
- physiology of the respiratory system;
- classification of respiratory hazards;
- air purifying respirators;
- respirator selection, use and limitations;
- fit testing, maintenance and cleaning;
- air supplying respirators/SBCAs/airline respirators;
- SCBA/airline respirators check-out procedures and donning;
- SCBA/airline respirators field exercise.

OSHA 8-Hour Hazardous Waste Site Refresher training may contain the following topics:

- company health and safety program review;
- regulatory update;
- medical surveillance program;
- occupational exposure limits;
- PPE;
- respiratory protection;
- monitoring instruments;
- heat and cold stress;
- safe work practices;
- trenching and excavations;
- confined space recognition;
- Department of Transportation (DOT) Hazardous Materials Shipping;
- blood-borne pathogens
- site safety plans;
- health and safety documentation;
- critiques of incidents and activities.

OSHA permits equivalent training to meet the required 40-hour and supervisor courses in lieu of completing the formal courses. This equivalent training "includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience." Any site work experience must have been completed prior to the March 19, 1987 (effective date of the 29 CFR 1910.120 Interim Final Standard) in order to be considered for equivalency.

Personnel certified still must be trained in the site-specific hazards and have appropriate supervised field experience at any new site operation, in accordance with 29 CFR 1910.120 (e) (9).

9.2 HAZARD COMMUNICATION TRAINING

HAZCOM training applies to any CRM personnel who work with hazardous chemicals, such as those used in laboratory operations, technical illustrations, and in some equipment decontamination processes. Consumer products, such as correction fluids (white-out, etc.) and household-type cleaning products (glass cleaner, cleaners, etc.), may also be covered. Such courses cover, as a minimum,

- summary of the standard;
- chemical and physical properties of hazardous materials (e.g., flash point, reactivity) and methods that can be used to detect the presence or release of chemicals (including chemicals in unlabeled pipes);
- physical hazards of chemicals (e.g., potential for fire, explosion, etc.);
- health hazards, including signs and symptoms of exposure, associated with exposure to chemicals and any medical condition known to be aggravated by exposure to the chemical;
- procedures to protect against hazards (e.g., PPE, proper use, and maintenance; work practices or methods for the proper use and handling of chemicals; and procedures for emergency response);
- MSDS review

9.3 FIRST AID AND CPR TRAINING

OSHA requirements state that "In the absence of an infirmary, clinic, or hospital, in near proximity to the workplace, which is used for the treatment of all injured employees, a person or persons shall be adequately trained to render first aid." It is generally accepted that OSHA interprets "in near proximity" to mean a response time of as little as three and as much as fifteen minutes.

First aid and CPR training sessions in most cases will be provided by agreements with local chapters of the American Red Cross or American Red Cross-certified contract providers.

In order to maintain the certification, one must demonstrate competency on a periodic basis. CPR requires an annual re-certification, while first aid is triennial.

9.4 CONSTRUCTION SAFETY TRAINING

Construction safety training and accident prevention training may be important for CRM professionals who work at or near a construction projects or perform construction-related field activities. Construction safety courses are typically a minimum four to ten hours in length (longer for a broader range of topics) and address the following topics, as appropriate:

- overview of 29 CFR 1926 (OSHA Construction Safety Standards)
- recognition and elimination of unsafe acts
- materials handling
- compressed gas cylinders
- accident reporting
- excavations
- electrical safety
- back injury
- crane safety
- fall protection
- PPE
- fire prevention
- housekeeping
- vehicle and heavy equipment hazards and control
- public safety
- flammable and combustible liquids
- HAZCOM
- confined space entry overview
- hand tools
- ladders and scaffolding
- hearing conservation
- hot work including welding, cutting and heating
- blood-borne pathogens and other biological hazards

If a project or site has unique hazards, additional training may be necessary before the onset of site operations. Additional training may be required to:

- inform the employees of the particular hazards;
- describe the measures employees may take to protect themselves; and
- describe particular warning signals and/or emergency response actions.

9.5 SUBSTANCE-SPECIFIC STANDARDS

Subpart Z or 29 CFR 1910 contains many "substance-specific" standards that establish a wide range of criteria to follow when personnel are working with the particular chemicals. Each standard usually contains specific training requirements that must be followed. Note that special medical monitoring and other requirements may also be contained in these standards. The following chemicals have specific standards:

Asbestos
Coal Tar Pitch Volatiles
4-Nitrobiphenyl
alpha-Naphthyl amine

Methyl chloromethyl ether
3,3'-Dichlorobenzidine
bis-Chloromethyl ether
Beta-Naphthyl amine
Benzidine
4-Aminodiphenyl
Ethyleneimine
beta-Propiolactone
2-Acetylaminoflourene
4-Dimethylaminoaobenzene
N-Nitrosodimethylamine
Vinyl chloride
Inorganic arsenic
Lead
Cadmium
Benzene
Methylenedianiline
Coke-oven emissions
Blood-borne pathogens (see (HS 370)
Cotton dust
1,2-dibromo-3-chloropropane
Acrylonitrile
Ethylene oxide
Formaldehyde

10.0 RESPIRATORY PROTECTION FOR CRM PROFESSIONALS

Various cultural resources activities may place individuals in situations where respiratory hazards may be present. CRM personnel who are required to work in such situations should receive respiratory protection training in accordance with the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), the ANSI Practices for Respiratory Protection (Z88.2), and the NIOSH Guide to Respiratory Protection. Respiratory protection for CRM professionals can vary greatly from simple dust masks to self-contained breathing apparatus (SCBA). The level of protection will depend on the regulatory requirements and potential hazard.

Only trained CRM professionals should use respirators and these should be approved and certified. Use of this equipment should be in accordance with the instructions, and individuals should be properly fitted. Individuals who may be involved with a level of protection, whether for waste site operations or in any situation where respiratory protection is used, should receive medical clearance to ensure that they are medically qualified to wear this protection.

10.1 TYPES OF RESPIRATORS

Only respirators approved and certified by NIOSH or the MSHA under 30 CFR Part 11 should be used by personnel when respiratory protection is required. Respirators are typically divided into two categories, air purifying respirators and air supplying respirators. The face mask portion of a respirator can be quarter-faced, half-faced, and full-faced.

AIR PURIFYING RESPIRATORS (APR)

These respirators remove contaminants from the air breathed but do not supply oxygen. They cannot be worn in oxygen-deficient atmospheres. APRs should be used in only specific instances including:

- only when the chemical or biological contaminants have been identified, the quantity measured, and the proper type specified;
- ***not*** in atmospheres containing less than 19.5% oxygen or in IDLH atmospheres;
- ***not*** when the atmospheres require a higher level of protection. APRs have a limit of protection specific to contaminants and concentrations. These must be understood if APRs are used;
- ***not*** if contaminants have poor warning properties. If the APRs leak or fail to remove contaminants, individuals must be able to recognize the hazards;
- ***not*** to protect against chemical or biological agents that are not effectively removed by the device.

Particulate-Removing Respirators

Particulate-removing respirators are called "dust," "mist," or "fume" respirators and remove particulates by a filtering action before they can be inhaled. They offer ***no*** protection against atmospheres containing contaminant gases or vapors.

The airflow resistance of a particulate-removing respirator filter element increases as the quantity of particles it retains increase, thus increasing the breathing resistance. As a rule of thumb, when comfortable breathing is impaired because of due build-up, the filter should be replaced. The performance of some filter materials is also affected by open storage in very humid atmospheres and care should be taken in storing filter elements.

Gas and Vapor-Removing Respirators

Vapor and gas-removing respirators use cartridges or canisters containing chemicals to absorb or react with specific vapors and gases to remove them from the air breathed. The basic difference between a cartridge and canister is the volume of the absorbent. Generally, a "cartridge" refers to a smaller chemical-filtering element which attaches easily to the face piece, whereas a "canister" refers to a larger chemical-filtering element held in a harness connected to the face piece by a corrugated breathing tube. A color coded system is used to assist in identifying the approved uses for individual cartridges and canisters. Labels on the cartridge and canister will indicate the maximum concentration in which the element can be used and, in some cases, the service life or expiration date of the element. The label should ***always*** be reviewed to determine for what contaminants the cartridge or canister may be used.

Cartridges and canisters are available for protection against single chemicals, such as ammonia, or against entire classes, such as organic vapors, depending on the cartridge or canister used. However, even though a cartridge or canister label indicates it may be useful against a class of contaminants (e.g., organic vapors), that ***does not*** ensure that it is useful for all chemicals within that class.

AIR OR ATMOSPHERE SUPPLYING RESPIRATORS

Air or atmosphere supplying respirators, rather than removing the hazardous material from the air, exclude the workplace air altogether and provide clean air from an independent source. As a result, they can be used in oxygen-deficient atmospheres.

Supplied-Air Respirators

A supplied-air respirator uses a central source for breathing air that is delivered through an air supply line or hose. The trailing air supply hose or line can severely restrict the wearer's mobility, and can become tangled with other lines, if more than in person is using an airline respirator in the exclusion zone. This factor may make a supplied-air respirator unsuitable for those who must move frequently between widely-separated work stations.

A great advantage of the airline respirator is that it can be used for long, continuous periods.

The air source for airline devices is either a compressor or air tanks. The following requirements meet the specifications for Grade D breathing air, and apply to air supplies for airline devices.

- The oxygen content of the compressed air should be between 19.5 percent to 23.5 percent oxygen and the rest mainly nitrogen;
- Hydrocarbon concentrations must not exceed 5mg/m^3;
- The carbon monoxide concentration must not exceed 20 parts per million (ppm);
- Carbon dioxide concentrations must not exceed 1,000 ppm; and
- There must not be any pronounced odor present.

To be assured that these conditions are met, the following steps should be taken:

- The air compressor must be located where contaminated air cannot enter the system;
- Alarms indicating compressor failure and overheating must be installed in the system;
- If the compressor is oil-lubricated, it must have a high temperature and/or carbon monoxide (CO) alarm. If no CO alarm exists, frequent CO monitoring of the air supply must be made to ensure that the CO level does not exceed 20 ppm;
- Bottled, compressed air that is obtained from a vendor must be accompanied by a certification attesting that the air meets or exceeds Grade D specifications; and
- All airline couplings must be incompatible with outlets for other gas systems.

In a demand air device, the air enters the face piece only on "demand" of the wearer (i.e., when the person inhales). This is due to the nature of the valve and pressure regulator. During inhalation there is a negative pressure in the mask, so if there is leakage, contaminated air may enter the mask and be breathed by the user. The leakage problem is a major drawback of the demand device. Demand devices are also available with a full-face mask, which provides a better seal than does the half-mask.

Pressure Demand Airline Device

The pressure demand device has a regulator and valve design such that there is a continuous flow of air (until a fixed static pressure is attained) into the face piece at all times, regardless of the "demand" of the user. The airflow into the mask creates a positive

pressure outward. As such, there is no problem of contaminant leakage into the face piece, which is a significant advantage of this type of device.

Self Contained Breathing Apparatus

The self-contained breathing apparatus (SCBA) (SCUBA, if used underwater) allows the user to carry along a respirable breathing supply without the need for a stationary air source, such as a compressor, to provide breathable air. The SCBAs used by CRM professionals should provide a 30-minute supply of air.

Since SCBAs provide a breathable air supply that is not dependent on a trailing hose or airline, a pressure-demand SCBA may be used in atmospheres immediately dangerous to life or health. However, an open-circuit demand (but not a pressure-demand) SCBA may have face piece leakage and ***cannot*** be used in IDLH environments. In addition, some devices are only approved for "escape from" and not "entry into" a hazardous atmosphere.

Combination Atmosphere Supplying Respirator: Supplied Air SCBA

Designed primarily as a long duration device, this type of respirator combines an airline respirator with an auxiliary air supply (usually compressed air) to protect the worker against the possible failure of the primary air supply (the airline). The additional supply can be approved for 5 to 15 minutes or even longer. The choice depends upon the length of time required to escape from the toxic atmosphere if the primary air supply failed. This type of unit may be used in IDLH environments.

Open-Circuit SCBA

An open-circuit SCBA exhausts the exhaled air into the atmosphere instead of recirculating it. A tank of compressed air carried on the back supplies air via a regulator to the face piece. Because there is no recirculating of air, the service life of the open-circuit SCBA is shorter than a closed-circuit system. The air supply is limited to the amount in the cylinder, and, therefore, the respirator cannot be used for extended periods without recharging or replacing the cylinders. Because these respirators are bulky and heavy, they are often unsuitable for strenuous work or use in confined spaces. Two types of open-circuit SCBA are available, "demand" and "pressure demand."

10.2 RESPIRATOR SELECTION CRITERIA

The selection of respiratory protective equipment should be based upon the following:

- identification of the hazard;
- evaluation of the hazard level;
- consideration of the user's personal characteristics;

- consideration of the conditions of use;
- use of an approved respirator.

IDENTIFICATION OF THE HAZARD

The type of respiratory hazard that may require the use of a respirator generally includes one of the following five types:

- **Gas or Vapor Contaminant** - Gases are substances which normally exist as such at ordinary temperature and pressure (e.g., acetone or benzene vapors).

- **Particulate Contaminants** - Particulate contaminants consist of tiny particulates or droplets of a substance. Many of these particulates are so small (less than 50 microns in diameter) they cannot be seen. Particulates less than 10 microns in diameter can be easily inhaled; particles less than 5 microns in diameter are small enough to reach deep into the lungs or into the alveoli.

  Particulates are produced by mechanical means through the disintegration processes, such as sieving, grinding, crushing, drilling, blasting or spraying, or by physicochemical reactions, such as combustion, vaporization, distillation, sublimation, calcination or condensation.

- **Combination of Contaminants** - Gaseous and particulate contaminants frequently occur together. Paint spraying, for example, produces both paint mist (particulate) and solvent vapors (gaseous). Smoke also contains particulates and gases.

- **Oxygen-Deficient Atmospheres** - In an oxygen-deficient atmosphere, the problem is not the presence of something harmful but the absence of something essential. Such atmospheres are most commonly found in confined and usually poorly ventilated spaces, such as silos, petrochemical tanks, and the holds of ships. Oxygen-deficient atmosphere are classified as immediately dangerous to life or health. For OSHA compliance purposes, an oxygen-deficient atmosphere contains less than 19.5 percent oxygen.

- **Immediately Dangerous to Life and Health (IDLH)** -This is an atmosphere where worker exposure can:

  - cause serious injury or death within a short period of time (e.g., high concentrations of carbon monoxide or hydrogen sulfide);

- cause serious death-delayed effects (e.g., airborne radioactive materials or cancer causing agents);
- prevent exposed personnel from escaping the environment within 30 minutes.

Evaluation of the Hazard Level

The second consideration in selecting a respirator is the level or concentration of the hazard requiring the respirator. The concentration of the air contaminant and how it compares to the TLV or PEL for that substance must be known in order to determine the "protection factor" that the respirator must provide, which is the ratio of the concentration of the contaminant outside the respirator to that inside the respirator under the conditions of use. Respirators should be selected so that the concentration inside the respirator will not exceed the TLV or PEL. The formula below summarizes the calculation.

$$MUC = PF \times TLV$$
$$PF = MUC/TLV$$

Where MUC = maximum use concentration
PF = protection factor
TLV = threshold limit value (or use PEL [permissible exposure limit]).

Consideration of the User's Personal Characteristics

Medical Condition

The use of any type of respirator will impose some physiological stress on the user. For example,

- Air-purifying respirators make breathing more difficult because the filter or cartridge impedes the flow of air;
- The special exhalation valve on an open circuit pressure demand respirator requires the wearer to exhale against some resistance;
- The bulk and weight of an SCBA can be a burden;
- If the wearer is using an airline respirator, they might have to drag up to 300 feet of hose around.

All these factors can significantly increase CRM worker's workload and wearers shall have medical examinations to determine if they are medically able to wear respiratory protective equipment without aggravating preexisting medical problems.

Emotional and Mental Factors

Emotional and mental factors must also be considered when employees wear respirators. Some individuals feel claustrophobic when wearing them, especially with protective clothing. If there are indications that an individual suffers from chronic claustrophobia, that individual should not be placed in such a situation.

Physical Characteristics

Scars, hollow temples, very prominent cheekbones, deep skin creases, and lack of teeth or dentures may cause respirator face piece sealing problems. Full dentures should be retained when wearing a respirator, but partial dentures may or may not have to be removed, depending upon the possibility of swallowing them under duress.

Corrective Lenses

If glasses are required, they shall be worn so as not to effect the respirator.

If a full-face piece respirator is worn, a proper seal cannot be established due to eyeglasses' temple bars extending through the sealing edge of the facepiece. Wearing contact lenses with any type of respirator is not permitted.

Systems have been developed for mounting corrective lenses inside full facepieces; and when a person must wear corrective lenses, the proper face piece and lenses must be obtained to provide good vision, comfort, and a gas-tight seal.

CONSIDERATION OF THE CONDITIONS OF USE

Eye Irritation

If the air contaminant can cause eye irritation a full-face piece respirator should be used.

Skin Irritation or Absorption through the Skin

Some airborne contaminants are extremely irritating to the skin (e.g., ammonia or hydrochloric acid), while others are capable of being absorbed through the skin and into the bloodstream with serious and possible fatal results (e.g., hydrochloric acid or organophosphate pesticides, such as parathion, malathion or tetratjyl pyrophosphate).

Rubber face piece material can cause skin irritation dermatitis for some individuals. The use of non-allergenic silicone facepieces can help alleviate this condition.

Duration of Task

Work time usually determines the period for which respiratory protection is needed, including time necessary to enter and leave a contaminated area. A SCBA or chemical cartridge respirator provides respiratory protection for relatively short periods, whereas an airline respirator provides protection for as long as the facepiece is supplied with adequate respirable air. Particulate-filter respirators can provide protection for long periods without need for filter replacement, but only if the atmospheric particulate loading is low. Therefore, for protracted periods of use, an airline respirator offers definite advantages over a filter respirator. Some respirators have a means for indicating remaining service life. Some type of warning is available for all SCBA, which be a pressure gauge, timer or an audible or physical alarm. The user must understand the operation and limitations of each type of warning device. Most chemical-cartridge respirators have no indicator of remaining service life. Canisters and cartridges should be changed according to the manufacturer's directions, or as specified in a sire-specific health and safety plan.

Use of an Approved Respirator

Having considered the type of hazard, the level of the hazard, user characteristics, and the condition of use, a decision may be made concerning the appropriate type of respirator. As important as selecting the right type of respirator is the selection of an approved respirator. NIOSH provides a testing, approval, and certification program for respiratory protective devices. Approved devices are listed in the NIOSH publication, *NIOSH Certified Equipment List*. This publication is updated periodically with the addition of newly-approved equipment and deletion of equipment that has lost its approval. All approved devices have a "TC" (tested and certified) number permanently printed on each item. This number is referenced in the NIOSH Certified Equipment list described above. Only NIOSH/MSHA approved respiratory protective equipment should be issued to and worn by CRM professionals.

10.3 MEDICAL SURVEILLANCE

No CRM professional should perform a task that requires the use of a respirator unless it has been determined that the person is physically able to perform the task using an appropriate respirator. In baseline and subsequent medical examinations, participants will undergo, among others, a pulmonary function test. The results of this exam will be reviewed to determine the participant's fitness for use of respiratory protective equipment.

Some factors that may impose hardships on personnel required to wear respiratory protective equipment are described below:

Physiological Factors

Wearing any type of respirator imposes some physiological stress on the wearer. With air purifying devices, resistance to inhalation is always experienced because the filter or

chemical cartridge restricts airflow. In addition, the wearer must work against the exhalation valve upon expiration. Similar breathing resistance is encountered when using pressure-demand type airline respirators or SBE because the spring-loaded exhalation valve used is designated to always maintain positive pressure within the mask. This feature requires an additional 1.5 to 3.0 psi of exhalation pressure to open this type of exhalation valve. The bulk and weight of SCBAs (up to 35 pounds) is of some concern, especially when a CRM worker must perform strenuous work. Airline respirator units require that the wearer drag around the hose or airline, which provides additional physiological stress.

Pulmonary Factors

In the physical exam, respirator wearers are examined for any evidence of respiratory impairment such as emphysema, obstructive lung disease, or bronchial asthma. Historical and clinical evidence of impairment of pulmonary function, including x-ray findings or a reduction in vital capacity or forced expiratory volume, may justify a restriction from wearing a respirator that restricts inhalation and exhalation, even though the individual may be able to perform adequately in a continuous-flow supplied air device.

Cardiovascular Consideration

The use of air-purifying demand or pressure-demand supplied air devices may pose a serious problem for workers with cardiovascular disease, but they may be able to use continuous flow devices. As always, the physician must make a final determination. If a worker has cardiovascular disease, serious consideration should be given to reassigning the individual to a task that does not require the use of respiratory protection and does not respond to an emergency situation or escape from a contaminated area while using a respiratory protective devices.

Health Conditions

Conditions that may prevent CRM personnel from wearing a respirator, and thus from working in a contaminated area, include:

- diabetes,
- epilepsy,
- alcoholism,
- use of certain medication,
- punctured ear drum,
- skin sensitiveness,
- impaired or non-existent sense of smell, and
- any other condition that the physician determines would place the worker at added physical risk.

10.4 RESPIRATOR FIT TESTING

Respirator fit testing is required by OSHA and ANSI. Fit testing is required at least annually, although OSHA requires it every six months for asbestos workers. The following policies are observed in the fitting and use of the respirator:

- Fit testing for positive pressure respirators is not required;
- Personnel shall be allowed to use only the specific make(s) and model(s) of air purifying respirators for which the person has obtained a satisfactory fit verified through fit testing procedures;
- A CRM worker is not permitted to use any respirator not previously fit tested or if the results of the fit test indicated that the person was unable obtain a satisfactory fit;
- No facial hair or glasses are allowed that will interfere with the attainment of a good seal. Facial hair (e.g., some moustaches) that does not interfere with a good face piece-to-face seal is permissible. However, facial hair, specifically beards, that contacts the sealing surface of the respirator is specifically prohibited;
- If it is found that a worker cannot obtain a good face piece-to-face seal because of facial features or medical factors, the worker shall not enter an atmosphere requiring the use of that equipment, and that equipment shall not be used.

RESPIRATOR FIT CONSIDERATIONS

Each make and model of respirator face piece has a slightly different fit. Although each manufacturer designs their facepiece to fit as broad a cross-section of the working population as possible, no respirator fits everyone.

Conditions which may adversely effect a good facepiece fit include:

- a beard,
- sideburns,
- a hairline that projects under the face piece,
- temple pieces on glasses,
- facial scars,
- facial injuries,
- round face shape
- dentures.

CRM personnel who are assigned to field operations in which respiratory protection ***may*** be required should be clean-shaven at the time of assignment. A neatly-trimmed moustache that does not extend beyond the corners of the mouth and does not otherwise interfere with acceptable respirator fit is permissible.

10.5 TRAINING

Although equipment selection is important to the success of a respiratory protection program, the proper use of the equipment is equally important. Proper use can be ensured by carefully training workers in the selection, use and maintenance of the provided respiratory equipment.

The training should cover at least the following topics:

- Respiratory Protection Program;
- overview of respiratory protection;
- physiology of the respiratory system;
- classification of respiratory hazards;
- air-purifying respirators;
- air-supplied respirators;
- respirator selection, use and limitations;
- fit testing, maintenance, and cleaning.

10.6 INSPECTION, MAINTENANCE, CLEANING, AND STORAGE

Respirator maintenance should be an integral part of a Protection Program. Wearing a poorly-maintained or malfunctioning respirator is, in one sense, more dangerous than not wearing a respirator at all because workers wearing defective devices think they are protected when in reality they are not. It is the responsibility of the Project Manager and/or Site Safety Officer to see that project personnel comply with inspection, cleaning, maintenance, and storage requirements. The program requires at a minimum:

- inspection for defects, including leak check;
- repair as required;
- cleaning and disinfecting; and
- proper and sanitary storage of equipment.

The maintenance program should ensure that each worker's respirator remains as effective as it was when it was new.

INSPECTION FOR DEFECTS AND MAINTENANCE

If properly performed equipment will be inspected thoroughly during the cleaning process and before the apparatus is used. The OSHA standard outlines two types of inspections—before and after use; and during cleaning

All respiratory equipment will be inspected thoroughly during the cleaning process and before the apparatus is used. Any defects will be repaired or the defective part replaced. Proper inspection, maintenance, and cleaning of respiratory equipment is the responsibility of the user of the equipment.

CLEANING AND STORAGE

OSHA 1910.134 requires that routinely-used respirators be collected, cleaned, and disinfected as frequently as necessary. Consideration should be given to cleaning and disinfecting each respirator after each use. Cleaning and sanitizing of the units should be accomplished following manufactures recommendations.

Respirators should be stored in a convenient and sanitary location to protect them against dust, sunlight, excessive heat or cold, excessive moisture, damaging chemicals and mechanical damage.

CRM professionals should develop a respiratory protection program if respiratory protection is to be used. This program should minimally require the following:

- the proper types of respirators are being used for the job;
- employees are trained in the use and properly perform positive/negative pressure fit tests prior to entering contaminated areas;
- individuals who are required to wear respirators have received proper training;
- respirators are inspected and maintained properly;
- respirator storage is satisfactory;
- respiratory hazards are monitored;
- the respirators being used are in good operating condition; and
- medical surveillance of the respirator user is being carried out.

11.0 SAFETY PRECAUTIONS SPECIFIC TO ARCHAEOLOGY

This section covers specific safety issues associated with cultural resources.

The following general safe work practices apply:

- Eating, drinking, chewing gum or tobacco and smoking are prohibited within the work area due to the possibility for transfer or ingestion of potential contaminants.

- Contact with potentially contaminated substances should be avoided. Puddles, pools, mud, etc., should not be walked through if possible. Kneeling, leaning, or sitting on equipment or on the ground should be avoided whenever possible.

- Upon leaving the exclusion area, hands, face and other exposed skin surfaces must be thoroughly washed. Disposable coveralls (when used) are to be removed and placed in a sealed container or plastic bag.

- Unusual site conditions shall be promptly conveyed to the Site Safety Officer and project management for resolution.

- A first-aid kit shall be available at the site.

- Field personnel should use all their senses to alert themselves to potentially dangerous situations (i.e., presence of strong, irritating, or nauseating odors).

12.0 EMERGENCY PLANNING DURING CULTURAL RESOURCES INVESTIGATIONS

Any time cultural resources field activities are conducted, pre-planning for emergency situations or emergency preparedness should occur. This can range from a simple posting of a listing of project specific emergency telephone numbers to a program including detailed procedures, such as for work conducted at hazardous waste sites or military installations, to ensuring communication with the outside world during fieldwork, especially in deep woods environments.

Emergency plans to ensure CRM worker safety in the case of emergency situations should be prepared and reviewed by all personnel. In the event of an emergency, field team members and/or safety personnel will employ site-specific emergency procedures detailed in either a site-specific safety plan or accident prevention plan. Depending on the nature of the cultural resources activity and location, emergency planning can involve some or all of the following aspects:

- Pre-emergency planning including emergency recognition and planning;
- Designation of personnel roles, authority, training, and communication;
- Identification of project-specific hazards, safety zones, and places of safe refuge (i.e, places to go in a lightning storm, meeting places for emergency events when survey crews are separated by large distances);
- Security and control;
- Evacuation routes, procedures and emergency signals;
- Decontamination;
- Emergency medical treatment and first aid;
- Emergency alerting and response procedures including the means of reporting emergencies;
- Protective and emergency equipment;
- Emergency monitoring equipment;
- Task-specific planning (i.e., lock-out/tag-out, confined space entry, trenching and excavations, etc.).

12.1 EMERGENCY MEDICAL TREATMENT AND FIRST AID

Emergency telephone numbers and reporting instructions for ambulance, physician, hospital, fire, police, and other persons to contact for information, clarification, or management functions should be posted at the job location. These emergency telephone numbers for medical emergencies should be posted at an appropriate location within the job site and near communication devices.

A first aid kit large enough to accommodate anticipated emergencies should be kept in the field vehicle, laboratory, or job site. If any injury should require advanced medical

assistance, emergency personnel should be notified. Emergency first aid treatment should only be administered by trained individuals and only to prevent further injury until professional treatment can be obtained. Consideration should be given to training field personnel in basic first aid and cardiopulmonary resuscitation (CPR).

In the event of an injury or illness, work should cease until the safety person and/or Field Director have examined the cause of the incident and have taken the appropriate action. Any injury or illness, regardless of extent, is to be reported on a designate Accident Report Form.

In summary, emergency preparedness should include the response system and actions necessary to minimize the consequences of accidents or emergencies including natural disaster and weather emergencies including means of communication, rescue, first aid, medical treatment, emergency response, emergency training, and emergency equipment.

GLOSSARY

(ACGIH) American Conference of Governmental Industrial Hygienists: The ACGIH is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year, called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

Acute: Severe often dangerous conditions in which relatively rapid changes occur.

Acute exposure: An intense exposure over a relatively short period of time.

ANSI (American National Standards Institute): ANSI is a voluntary membership organization (run with private funding) that develops consensus standards nationally for a wide variety of devices and procedures.

Asphyxiant: A chemical (gas or vapor) that can cause death or unconsciousness by suffocation. Simple asphyxiants, such as nitrogen, either use up or displace oxygen in the air. They become especially dangerous in confined or enclosed spaces. Chemical asphyxiants, such as carbon monoxide and hydrogen sulfide, interfere with the body's ability to absorb or transport oxygen to the tissues.

Autoignition Temperature: The temperature at which a material will self-ignite and sustain combustion in the absence of spark or flame.

Boiling Point: The temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which liquid changes to "vapor." The Boiling Point is usually expressed in degrees Fahrenheit. If a flammable material has a low boiling point, it indicates a special fire hazard.

"C" or Ceiling: A description usually seen in connection with a published limit. It refers to the concentrations that should not be exceeded, even for an instant. It may be written as Threshold Limit Value-Ceiling (TLV-C) or Permissible Exposure Limit-Ceiling (PEL-C).

Carcinogen: A substance or physical agent that may cause cancer in animals or humans.

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act.

CFR: Code of Federal Regulations.

Chemical: As broadly applied to the chemicals industry, an element or a compound produced by chemical reactions on a large scale for either direct industrial and consumer use or for reaction with other chemicals.

Chemical Abstracts Service Number (C.A.S.): Identifies a particular chemical with a unique C.A.S., a service of the American Chemical Society that indexes and compiles abstracts of worldwide chemical literature called "Chemical Abstracts."

Chemical Reaction: A change in the arrangement of atoms or molecules to yield substances of different composition and properties (See Reactivity).

Chronic: Persistent, prolonged, or repeated conditions.

Chronic Exposure: A prolonged exposure occurring over a period of days, weeks, or years.

Combustible: According to DOT and HFPA, combustible liquids are those having a flash point at or above 100°F (37.8°C) or liquids that will burn. They do not ignite s easily as flammable liquids. However, combustible liquids can be ignited under certain circumstances and must be handled with caution.

Concentration: The relative amount of a material in combination with another material. For example, 5 parts (of acetone) per million (parts of air).

Corrosive: A substance that, according to the DOT, causes visible destruction or permanent changes in human skin at the site of contact or is highly corrosive to steel.

Cubic Centimeter (cc): A volumetric measurement which is also equal to 1 millimeter

Cubic Meter (c^3): A measure of volume in the metric system; one cubic meter equals 1.31 cubic yards.

Cutaneous: Pertaining to or affecting the skin.

Decomposition: The breakdown of a chemical or substance into different parts or simpler compounds. Decomposition can occur due to heat, chemical reaction, decay, etc.

Density: The mass of a substance per unit volume. Gold is a very dense substance because a small amount weighs a lot. Plastic foams have low densities because large volumes weigh very little. The density of a substance usually compared to water, which has a density of 1. Substances which float in water have densities less than 1; substances which sink have densities greater than 1.

Dermal: Pertaining to or affecting the skin.

Dermatitis: An inflammation of the skin.

Dilution Ventilation: (See General Ventilation).

DOT (Department of Transportation): The DOT is the federal agency that regulates the labeling and transportation of hazardous materials.

Dyspnea: Shortness of breath; difficult or labored breathing.

EPA (Environmental Protection Agency): The EPA is the federal governmental agency responsible for administration of laws tp control and/or reduce pollution of the air, water, and land systems.

EPA Number: The number assigned to a chemical regulated by the EPA.

Epidemiology: The study of disease in human populations.

Erythema: A reddening of the skin

Evaporation Rate: The rate at which a material is converted to vapor (evaporates) at a given temperature and pressure when compared to the evaporation rate of a specific reference substance.

Explosive Limits: The amounts of vapor in the air which forms explosive mixtures. Explosive limits are expressed as LOWER EXPLOSIVE LIMITS and UPPER EXPLOSIVE LIMITS; these give the range of vapor concentrations in the air which will explode if heat is added.

Fahrenheit (^{0}F): A temperature scale.

FD&CA: Food, Drug, and Cosmetic Act.

FIFRA: Federal Insecticide, Fungicide, and Rodenticide Act.

Flammable Liquids: See EXPLOSIVE LIMITS.

Flammable Liquid: According to DOPT and NFPA a flammable liquid is one that has a flash point below 100^{0}F.

Flash Point: The lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture and burn when a source of ignition (sparks, open flame, cigarettes, etc.) Is present. Two tests are used to determine the flash point: open cup and closed sup. The test method is indicated on the MSDS after the flash point.

General Ventilation: Also known as General Exhaust Ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom ir. This is not the recommended type of ventilation to control contaminants that are h highly toxic; when there may be corrosion problems from the contaminant; when the worker is close to where the contaminant is being generated; or where fire or explosion hazards are generated close to the sources of ignition (See Local Exhaust Ventilation).

Gram: A metric unit of weight; one ounce equals 28.4 grams.

Grams per Kilogram (g/kg): This indicates the dose of a substance given to test animals in toxicity studies. For example, a dose may be grams (of substance) per kilogram of body weight.

Hazardous Material: Any substance or compound that has the capability of producing adverse effects on the health and safety of humans.

Health Hazard: Anything which can have a harmful effect on health under the conditions in which it is used or produced. There can be both ACUTE and CHRONIC health hazards.

HMIS: Hazardous Materials Identification System.

IARC: International Agency for Research on Cancer.

Ignitable: A solid, liquid, or compressed gas that has a flash point of less than 140°F. Ignitable material may be regulated by EPA as a hazardous waste, as well.

Ignition Temperature: The lowest temperature at which a substance will catch on fire and continue to burn. The lower the ignition temperature, the more likely the substance is going to be a fire hazard.

Incompatible: The term is applied to two substances to indicate that one material cannot be mixed with the other without the possibility of a dangerous reaction.

Ingestion: Swallowing. Taking a substance into the body through the mouth as food, drink, medicine, or unknowingly as on contaminated hands or cigarettes, etc.

Inhalation: The breathing in of an airborne substance that may in the form of gases, fumes, mists, vapors dust or aerosols.

Inhibitor: A substance that is added to another to [prevent or slow down an unwanted reaction or change.

Irritant: A substance that produces an irritating side effect when contacts the skin, eyes, nose, or respiratory system.

Kilogram (kg): A unit of weight in the metric system equal to 2.2 pounds.

Lethal Concentration 50 (LC_{50}): The concentration of an air contaminant that will kill 50 percent of the test animals in a group during a single exposure.

Liter (L): A metric measure of capacity; one quart equals 0.95 liter.

Local Exhaust Ventilation (also known as Exhaust Ventilation): A ventilation system that captures and removes the contaminants at the point they are being produced, before they escape into the workroom air. The system consists of hoods, ductwork, a fan, and possibly an air cleaning device. Advantages of local exhaust ventilation over general ventilation include: it removes the contaminant rather than dilutes it; it requires less airflow and this is more economical over the long term; and the system can be used to conserve or reclaim valuable materials. However the system must be properly designed with the correctly shaped and placed hoods; and correctly sized fans and ductwork.

Lower Explosive Limit (LEL) (also known as Lower Flammable Limit [LFL]): The lowest concentration of a substance that will produce fire or flash when an ignition source (flame, spark, etc.) is present. It is expressed in percent of vapor or gas in the air by volume. Below the LEL or LFL, the air/contaminant mixture us theoretically to "lean" to burn (See also UEL).

Melting Point: The temperature at which a solid changes to liquid. A melting range may be given for mixtures.

Milligram (mg): A unit of weight in the metric system; one thousand milligrams equal one gram.

Milligrams per cubic meter (mg/m^3): Units used to measure air concentrations of dusts, gases, mists and fumes.

Milligrams per kilogram (mg/kg): This indicates the dose of a substance given to animals in toxicity studies. For example, a dose may be 2 milligrams (of substance) per kilogram of body weight (of the experimental animal).

Mutagenic: Capable of changing cells in such a way that future cell generations are affected. Mutagenic substances are usually considered suspect carcinogens.

NEPA: National Environmental Policy Act.

NESHAP: National Emissions Standards for Hazardous Air Pollutants.

NFPA: National Fire Protection Agency.

NIOSH: National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services. NIOSH does research on occupational safety and health questions and makes recommendations to OSHA.

NTP: National Toxicology Program.

Occupational Exposure Limits: Maximum allowable concentrations of toxic substances in workroom air to protect workers who are exposed to toxic substances over a working lifetime.

Odor Threshold or Threshold Odor Concentration: The lowest concentration of a substance's vapor, in air that can be smelled. Odor thresholds are highly variable depending in the individual who breathes the substance and the nature of the substance.

OSHA: Occupational Safety and Health Administration, U.S. Department of Labor. OSHA Develops and enforces standards for occupational safety and health.

Oxidizer: A material which may cause the ignition of combustible materials without the aid of an external source of ignition or which, when mixed with combustible materials, increases the rate of burning of these materials when the mixtures are ignited.

Oxygen Deficiency: An atmosphere having less than the normal percentage of oxygen found in normal air. Normal air contains approximately 21 percent oxygen at sea level.

Parts Per Billion (ppb): Parts (of vapor or gas) per billion (parts of air) by volume.

Parts Per Million (ppm): Parts (of vapor or gas) per million (parts of air) by volume.

Permissible Exposure Limit (PEL): An exposure limit that is published and enforced by OSHA as a legal standard. PEL may be either a Time Weighted Average (TWA) exposure limit, (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling (C). The PEL's are found in Tables Z-1, Z-2, or Z-3 of OSHA regulations 29 CFR 1910.1000 (See also TLV).

Personal Protective Equipment (PPE): Any device or clothing worn by the worker to protect against hazards in the environmental. Examples a respirators, gloves, and chemical splash goggles.

pH: A measure of how acid or how caustic (basic) a substance is on a scale of 0 to 14. PH 0 indicates that a substance is very acid; pH 7 indicates that a substance is neutral; and pH 14 indicates that a substance is very caustic (basic).

Polymerization: A chemical reaction in which two or more small molecules combine to form larger molecules that contain repeating structural units of the original molecules. A hazardous polymerization is the above reaction, with an uncontrolled release of energy.

Pyrophoric: A chemical that will ignite spontaneously in air at temperature of 130°F (54.4°C) or below.

Reactivity: A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosion, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, and dropping, will usually be specified as "*Conditions to Avoid*" when a chemical's reactivity is discussed on an MSDS.

Respirator: A device which is designed to protect the wearer from inhaling harmful contaminants.

Respiratory Hazard: A particular concentration of an airborne contaminant that, when it enters the body by way of respiratory system or being breathed into the lungs, results in some bodily function impairment.

RCRA: *Resource Conservation and* Recovery Act.

RTECS: Registry of Toxic Effects of Chemical Substances.

SARA: The Superfund Amendments and Reauthorization Act.

Sensitizer: A substance that may cause no reaction in a person during initial exposures, but further exposures afterwards will cause an allergic response to the substance.

Short Term Exposure Limit (STEL or TLV-STEL): This is the maximum concentration to which workers can be expressed for a short period of time (15 minutes) for only four times throughout the day with at least 1 hour between exposure. Also, the daily TLV-TWA must not be exceeded.

SIC: Standard Industrial Classification. This is a system developed for use in classifying establishments by the type of activity in which they are engaged.

"Skin": This designation sometimes appears alongside a TLV or PEL. It refers to the possibility of absorption of the particular chemical through the skin and eyes. Thus, protection of large surface areas of the skin should not be considered to prevent skin absorption so that the TLV is not compromised.

Solubility: The amount of a substance that can be dissolved in a solvent, usually water.

Solvent: Usually, a liquid in which other substances are dissolved. The most common solvent is water.

Substance: Any chemical entity

Suspect Carcinogen: A substance that might cause cancer in humans or animals but has mot been proven to do so.

Synonym: Another name by which the same chemical may be known.

Systemic: Spread throughout the body; affecting many or all body systems or organs, not localized in one spot or area.

Teratogen: An agent or substance that may cause physical defects in the developing embryo or fetus when a pregnant female is exposed to that substance.

Threshold Limit Value (TLV): Airborne Concentrations of substances devised by the ACGIH that represents conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effects. TLVs are advisory exposure guidelines, not legal standards, that are based on evidence from industrial studies when they exist. There are three different types of TLVs. They are: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL) and Ceiling (TLV-C) (See also PEL).

Time Weighted Average (TWA): The average concentration, over a given work period (e.g., 8-hour workday), of a person's exposure to a chemical or an agent. The average is determined by sampling fir the contaminant throughout the time period. Represented as TLV-TWA or PEL-TWA.

TSCA: Toxic Substances Control Act.

Toxic Substance: Any substance which can cause acute or chronic injury to the human body, or which is suspected of being able to cause disease of injury under some conditions. Many toxic substances are chemicals or chemical mixtures, but there are other kinds of toxic substances as well (bacteria and viruses, for example).

Toxicity: The potential of a substance to exert a harmful effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place.

Trade Name: The commercial name or trademark name by which a chemical is known. One chemical may have a variety of trade names depending on the manufacturers or distributors involved.

Unstable Liquid: A liquid that, in its pure state or as commercially produced, will react vigorously in some hazardous way under shock conditions (i.e., dropping), certain temperatures, or pressures.

Upper Explosive Limit (UEL) (also known as Upper Flammable Limit [UFL]): Is the highest concentration)expressed in percent of vapor or gas in air by volume) of a substance that will burn or explode when an ignition source is present. Theoretically, above this limit, the mixture is said to be too "rich" to support combustion. The difference between the LEL and UEL constitutes the flammable range or explosive range of a substance. That is, if the LEL is 1 percent and the UEL is 5 percent the explosive range is 1 percent to 5 percent.

Vapor: The gaseous form of substances which are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids, such as solvents. Solvents with low boiling points will evaporate readily.

Vapor Density: The density of the gas given off by a substance. It is usually compared with air, which has a vapor density set at 1. If the vapor is more dense than air, (greater than 1), it will sink to the ground; if it is less dense than air (less than 1), it will rise.

Viscosity: A relative measure of how slowly a substance pours or flows. Very viscous substances, like molasses pour very slowly. Slightly viscous substances, like water, pour and splash easily.

Volatility: A measure of how quickly a substance forms vapor at ordinary temperatures.

APPENDIX A

SIMPLE/GENERIC HEALTH AND SAFETY PLAN (FORM)

Health & Safety Plan

Project Name: _____ Project & Task #: _____

Site Location: _____

HASP Author: _____ Date: _____

Approval: _____ Date: _____

Description of Site and Pertinent History: _____

_____

_____

_____

☐ Active Site ☐ Inactive Site ☐ Abandoned Site

ANTICIPATED HAZARDS

Chemical	Physical
☐ explosive/flam/ign	☐ noise
☐ carcinogen	☐ confined space
☐ radioactive	☐ trenching/excavation/drilling
☐ corrosive	☐ heights
☐ volatile	☐ water hazards
☐ reactive	☐ heat/cold stress
☐ medical waste/pathogen	☐ vehicular/heavy equipment
☐ acute toxicity	☐ electrical
☐ other _____	☐ unknown drums/containers

Planned Site Activities: _____

_____

_____

Field Team

(all personnel entering the exclusion zone meet the training and medical surveillance requirements of OSHA 29CFR1910.120)

Name	Responsibilities

KNOWN CHEMICAL HAZARD SUMMARY:

Compound	PEL or TLV	Routes of Exposure	Acute Exposure Symptoms	Odor Description	Good Warning Properties?	Monitoring Methods

A current Material Safety Data Sheet (MSDS) must be attached for materials used by field team, e.g., preservatives, other supplies.

SITE LAYOUT: Attach Site Map or sketch layout on reverse of this page.

Site Access Control and Egress Considerations: _____

_____

SPECIAL CONSIDERATIONS

HASP read by all team members?

- hospital/emergency info reviewed?
- PPE/respiratory protection available per HASP?
- site work during daylight hours only?
- heat/cold stress considered?
- no work during electrical storms?
- NO EAT/DRINK/SMOKE/CHEW UNTIL DECONNED
- all personnel know location/operation of drill rig kill switches?
- animal/insect/poison ivy considerations?

PERSONNEL PROTECTIVE EQUIPMENT:

Task	Protective Clothing	Gloves	Respirator	Other	Other
Other PPE details:					

SITE MONITORING

Task	Contaminant(s)	Instrumentation	Limitations, Etc.	Action Level for PPE Upgrade and/or Work Stoppage

SAMPLING

Describe Planned Sampling Activities: _____

_____

PPE During Sampling (list by task): _____

_____

PPE During Sample Handling/Packaging: _____

_____

DECONTAMINATION

Equipment Decon Solutions & Procedures: _____

_____

PPE Required During Equipment Decon? _____

_____

Personnel Decon: _____

_____

Disposal of Used PPE: _____

_____

Disposal of Decon Liquids: _____

_____

EMERGENCY CONTACTS Attach sketch of hospital route or use reverse side.

Fire/Police, Rescue Phone #: _____

Local Hospital Name/Phone #: _____

Client Contact: _____

Agency Contact(s): _____

Contact(s):

Project Manager Name/Home Phone: _____

Branch Office Contact: _____

Cellular Phone (if applicable): _____

SITE EVACUATION PROCEDURES

_____

_____

_____

_____

APPENDIX B

OSHA

GENERAL INDUSTRY AND CONSTRUCTION INDUSTRY

OUTLINE OF REGULATIONS

OSHA Regulations (Standards - 29 CFR)

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PART 1910 Occupational Safety and Health Standards

OSHA Regulations (Standards - 29 CFR)

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PART 1926 Occupational Safety and Health Standards