HEAT STRESS

SUBPART A - PURPOSE

The purpose of this program is to prevent heat-related illnesses. Wearing full-body protective suits, particularly chemically impervious suits, on a hazardous waste site puts a worker at considerable risk of developing a heat-related illness, including heat stroke which is often fatal.

SUBPART B - POLICY

When employees are working in hot / humid environments, potable water will be provided and where it is not plumbed or otherwise continuously supplied, it shall be provided in sufficient quantity throughout the shift.

If an employee is suffering or is believed to be suffering from heat illness, an area with shade that is either open to the air or with ventilation for cooling will be provided and will be permitted at all times. The employee will be put on a less strenuous work regiment for the remainder of the day and/or the following day until the symptoms reside.
Generally when working in hot / humid environments all precautions will be taken so that the employees will be protected. They will be allowed to take more water breaks. Environmental factors will be closely monitored. The most common factors are air temperature, heat index, humidity, radiant heat sources, and air circulation.

Physical factors will also be taken into consideration before performing a task that could lead to heat related illnesses. These factors include the type of work, level of physical activity, the duration of the job, and the clothing that the employees are wearing.

In addition, supervisors are to take into consideration personal factors such as the age of the employee, weight/fitness, and drug/.alcohol use prior to assigning the task to employees.

All workers on sites where heat stress may be a problem will be exposed for progressively longer periods. Workers who have had previous exposures to high heat are not at as great a risk as those with no previous exposure. Based on NIOSH recommendations (1986), workers who have had previous experience, will be exposed to heat on the following regimen: 50% exposure on day 1, 60% on day 2, 80% on day 3, and 100% on day 4. For new workers who will be similarly exposed, the regimen should be 20% on day 1, with a 20% increase in exposure each additional day. These schedules **do not** apply to workers wearing impermeable suits. Their exposures must be much shorter. See the section on personal protective equipment.

SUBPART C - INTRODUCTION

Any outdoor operations conducted in hot weather, such as construction work, equipment operation, or hazardous waste site activities may cause heat stress problems for workers and is covered by this program. There is no OSHA standard on heat stress. This program is based on primarily recommended policy by the agency. The main sources for this heat stress program include:

1. OSHA's Technical Manual, (OSHA Instruction CPL 2-2.20B, February 5, 1990);
2. the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, "October 1985. (The Four Agency Manual); and
3. The American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Chemical Substances and Physical Agents, 1996-1997."

This program is built on the following key understandings:

1. A person's physical condition has been shown by the military to be an important factor in preventing heat-related problems. Workers will be medically evaluated prior to being allowed to work in hot environments.

2. Acclimatization has been demonstrated to be an important effect in preventing heat stress illness. Consequently, exposure to hot work will increase gradually, over the schedule suggested by the National Institute for Occupational Safety and Health.
3. Environmental monitoring using the Wet Bulb Globe Temperature (WBGT) is valuable in predicting a work-rest schedule that can prevent most heat-related illnesses.
4. Impermeable protective clothing, particularly Level A and B ensembles, are special cases. WBGT readings cannot be used safely to predict heat stress conditions when workers are wearing this level of protection. Consequently, heightened level of concern and increased precautions are required.
5. Increasing the intake of fluids during hot work helps to prevent heat stress problems.
6. Heat stroke cases are medical emergencies and require immediate attention. Additionally, equipment for effective cooling of victims must be kept on site.
7. Training is an effective tool for preventing heat-related illnesses. BBGCI requires all supervisors on the site to be trained on preventing problems, recognizing symptoms, and handling emergencies prior to becoming a field supervisor.

SUBPART D - BACKGROUND ON HEAT STRESS

Causes

- Age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs, and a variety of medical conditions such as hypertension all affect a person's sensitivity to heat. Prior heat injury predisposes an individual to additional injury.
- It is difficult to predict just who will be affected and when, because individual susceptibility varies. In addition, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction, and relative humidity all affect an individual's response to heat.

Heat Stroke

- Heat stroke occurs when the body's system of temperature regulation fails and body temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict. Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a

lack of sweating (usually); hot, red, dry skin; and an abnormally high body temperature, e.g., a rectal temperature of 41 degrees C (105.8 degrees F). If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of work load and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict. Nearly half of heat stroke victims die or have permanent brain damage. Consequently, rapid cooling treatment must take place immediately and professional medical assistance must be summoned simultaneous to treatment to save a heat stroke victim's life. (See first aid section).

Heat Exhaustion

- The signs and symptoms of heat exhaustion are headache, nausea, vertigo, weakness, thirst, giddiness, cool clammy skin, and paleness. Fortunately, this condition responds readily to prompt treatment. Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, a medical emergency. Workers suffering from heat exhaustion should be removed from the hot environment and given fluid replacement. They should also be encouraged to get adequate rest. NOTE: Giving fluids to an unconscious person should never be attempted.

Heat Collapse ("Fainting")

- In heat collapse, the brain does not receive enough oxygen because blood pools in the extremities. As a result, the exposed individual may lose consciousness. This reaction is similar to that of heat exhaustion and does not affect the body's heat balance. However, the onset of heat collapse is rapid and unpredictable. To prevent heat collapse, the worker should gradually become acclimatized to the hot environment.

Heat Cramps

- Heat cramps are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. Cramps can be affected by both too much and too little salt. Cramps appear to be caused by the lack of water replenishment. Excess

salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments. Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Recent studies have shown that drinking commercially available carbohydrate-electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

Heat Rashes

- Heat rashes are the most common problem in hot work environments. Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by un-evaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

SUBPART E - ACCLIMATIZATION

Background

- Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during the first week of exposure to hot environmental conditions. The recommended heat stress threshold limit values (TLVs) are valid for acclimated workers who are physically fit American Conference Governmental Industrial Hygienists (ACGIH). After a period of acclimatization, the same activity will produce fewer cardiovascular demands. The worker will sweat more efficiently (causing better evaporative cooling), and thus will more easily be able to maintain normal body temperatures. The military demonstrated a five to tenfold reduction in the seasonal incidence in heat casualties when a program was instituted that required, among other things, a breaking-in period for new recruits of exposure to heat (Minard 1961).

SUBPART F - FLUID REPLACEMENT

- Cool (50-60 degrees F) water must be made readily accessible to workers. Ideally, the water should be placed close to the workplace so that the worker can reach it without abandoning the work area. On hazardous waste jobs where workers are in contaminated environments, wearing respiratory protection, and break areas must be established.

- Thirst is not a good indicator of the need for replenishment. On a hot job, workers can lose up to one quart an hour but it is difficult to drink that much at any one time. Consequently, workers should be encouraged to drink small amounts frequently, e.g., one cup every 15-20 minutes. Workers should be encouraged to salt their food well during the hot season and particularly during hot spells. If the workers are un-acclimatized, salted drinking water should be made available in a concentration of 0.1% (1 level tablespoon of salt to 15 quarts of water). The added salt should be completely dissolved before the water is distributed, and the water should be kept reasonably cool. Commercial replacement drinks, such as Gatorade, can be used instead of salted water. These drinks are valuable at the beginning of hot work but are not necessary for acclimatized individuals.

SUBPART G - ADMINISTRATIVE CONTROLS

Training

- Training is the key to good work practices. Unless all employees understand the reasons for using new, or changing old, work practices, the chances of such a program succeeding are greatly reduced.
- NIOSH (1986) states that a good heat stress training program should include at least the following components:

  - Knowledge of the hazards of heat stress.
  - Recognition of predisposing factors, danger signs, and symptoms.
  - Awareness of first-aid procedures for and the potential health effects of heat stroke.
  - Employee responsibilities in avoiding heat stress.
  - Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments.
  - Use of protective clothing and equipment, and
  - Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs.

Other controls

- The following administrative controls can be used to reduce heat stress. This list should be evaluated on each job to determine which are pertinent and could realistically be implemented.

- Reduce the physical demands of work, e.g., excessive lifting or digging with heavy objects.
- Provide recovery areas, e.g., air-conditioned enclosures and rooms.
- Use shifts, e.g., early morning, cool part of the day, or night work.
- Use intermittent rest periods with water breaks.
- Use relief workers.
- Use worker pacing.
- Assign extra workers and limit worker occupancy, or the number of workers present, especially in confined or enclosed spaces.

SUBPART H - AUXILIARY BODY COOLING

- There is a broad range of commercially available cooling vests available that can be effective in some instances. Use of these units must be considered on a project by project basis. Ice vests, though heavy, may accommodate numerous ice packets, which are usually filled with water. Carbon dioxide (dry ice) can also be used as a coolant. The cooling offered by ice packets lasts only 2 to 4 hours at moderate to heavy heat loads, and frequent replacement is necessary. However, ice vests do not encumber the worker and thus permit maximum mobility. Cooling with ice is also relatively inexpensive.
- Wetted clothing is another simple and inexpensive personal cooling technique. It is effective when reflective or other impermeable protective clothing is worn. The clothing may be wetted terry cloth coveralls or wetted two-piece, whole-body cotton suits. This approach to auxiliary cooling can be quite effective under conditions of high temperature and low humidity, where evaporation from the wetted garment is not restricted.
- Water-cooled garments range from a hood, which cools only the head, to vests and "long-johns," which offer partial or complete body cooling. Use of this equipment requires a battery-driven circulating pump, liquid-ice coolant, and a container. Although this system has the advantage of allowing wearer mobility, the weight of the components limits the amount of ice that can be carried and thus reduces the effective use time. The heat transfer rate in liquid cooling systems may limit their use to low-activity jobs; even in such jobs, their service time is only about 20 minutes per pound of cooling ice. To keep outside heat from melting the ice, an outer insulating jacket should be an integral part of these systems.
- Circulating air is the most highly effective, as well as the most complicated, personal cooling system. By directing compressed air around the body from a supplied air system, both evaporative and convective cooling is improved. The greatest advantage occurs when circulating air is used with impermeable garments or double cotton overalls. One type, used when respiratory protection is also

necessary, forces exhaust air from a supplied-air hood ("bubble hood") around the neck and down inside an impermeable suit. The air then escapes through openings in the suit.

SUBPART I - PERSONAL PROTECTIVE EQUIPMENT

- Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount and type of personal protective equipment (PPE) worn. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms and increases energy expenditure. Once PPE is selected, the safe duration of work/rest periods should be determined based on the:

  - anticipated work rate;
  - ambient temperature and other environmental factors;
  - type of protective ensemble; and
  - individual worker characteristics and fitness.

- The weight of a self-contained breathing apparatus (SCBA) increases stress on a worker, and this stress contributes to overall heat stress. Chemical protective clothing such as totally encapsulating chemical protection suits greatly add to the heat stress problem. Level A protection should be seen as a significant risk of heat stroke and the risk of chemical exposure must be weighed directly against the known risk of heat stroke. Consequently, the choice of Level A ensemble will require a written heat stress management plan for each intended use. The plan must be site specific and identify project personnel by name. Only individuals with medical clearance to wear Level A will be allowed to do so.

SUBPART J - EMERGENCY PROCEDURES

First aid for Heat Stroke

- If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area and their clothing removed quickly. Full decontamination should not be attempted prior to removing chemically-resistant suits. The worker's skin should be wetted and air should be moved aggressively around the worker to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness

of first aid treatment. Regardless of the worker's protests, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

First Aid for Heat Exhaustion

- Workers showing symptoms of heat exhaustion should be taken out of protective clothing and moved to a shaded, and hopefully cool, area. They should be given fluids and allowed to rest. They may not need medical attention but **they must not be returned to work that day.**

NOTE: Do not attempt to give fluids to an unconscious person.

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