THE UNIVERSITY OF TEXAS AT AUSTIN

UTILITIES AND ENERGY MANAGEMENT

HEAT STRESS AND SUN OVEREXPOSURE PROGRAM

September 2007

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1.0 INTRODUCTION

1.1 Application

This policy applies to all University of Texas at Austin Utilities personnel and those contractors that enter the Power Plant and Chilling Station facilities. Visitor and guests of Utilities must abide by the same policies unless approval of the Director of Utilities has been given to do otherwise. Contractors, visitors and quests that enter any restricted work area must first go through safety orientation from the Department.

1.2 Purpose

This document establishes requirements to assess and mitigate heat stress hazards.

1.3 General

Owing to the many different trades in the Department and to the work performed, personnel who enter any University of Texas at Austin Utilities Power Plant and Chilling Station facilities must understand the individual department's requirements for preventing heat stress related injuries.

1.4 OSHA Standards

The Occupational Safety and Health Administration (OSHA) standards for general industry worker safety are codified under Title 29 of the Code of Federal Regulations.

OSHA does not have a specific regulation covering heat stress hazards. However, the "General Duty Clause," Section 5(a)(1) of the Occupational Safety and Health Act of 1970 (the Act), requires each employer to, "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm." OSHA has previously used the General Duty Clause to cite employers that have allowed employees to be exposed to potential serious physical harm from excessively hot work environments, and the specific requirements pertaining to PPE are published at:

1.5 Management Responsibilities

It is management's responsibility to provide a safe workplace for the employees of Utilities with the realization that employees are ultimately responsible for their own personal safety. Management shall assess the workplace or designate a competent person within the Department to determine if heat stress hazards are present or likely to be present that would necessitate the use or engineering controls, administrative controls or PPE.

Management is held accountable for promoting safety on and off the job, providing a safe work environment in which hazards are controlled when elimination of those hazards is not feasible, and for the implementation of systems and techniques designed to prevent incidents from occurring. Individuals will be provided the necessary training and education to ensure their ability to identify workplace heat stress exposures and control risks.

1.6 Employee Responsibilities

Employees are responsible for their own safety and that of their coworkers. Employees must comply with their section's safety requirements and those of other Utility sections they may enter, as well as any other occupational safety and health standards, rules, regulations, and orders that are applicable and practical. Each employee must wear or use prescribed protective equipment while working. Employees are responsible for reporting hazardous conditions and dangers to their supervisor. They must also report any job-related injury or illness to the University and seek treatment promptly. They have a responsibility to work in the manner required by the Department. Employees have the right to refuse unsafe work. Violations of Utilities policy and these standards may be cause for job-related disciplinary action.

1.7 Medical Certifications

If an employee have a medical condition or are taking over-the-counter medications that might put them at special risk for heat related injury, he should promptly notify his supervisor. Alternate means of protection from heat stress may be devised that accommodate the employee's situation. The Utilities Safety Office will review these situations on a case-by-case basis.

2.0 DEFINITIONS

Acclimatization (or acclimation) is adaptation to a new climate, such as a new temperature, altitude or environment.

Conduction is the transfer of heat between materials that contact each other. Heat passes from the warmer material to the cooler material. For example, a worker's skin can transfer heat to a contacting surface if that surface is cooler, and vice versa.

Convection is the transfer of heat in a moving fluid. Air flowing past the body can cool the body if the air temperature is cool. On the other hand, air that exceeds 35°C (95°F) can increase the heat load on the body.

Dry bulb (DB) temperature is measured by a thermal sensor, such as an ordinary mercury-in-glass thermometer, that is shielded from direct radiant energy sources.

Electrolytes are various ions, such as sodium, potassium, or chloride, required by cells to regulate the electric charge and flow of water molecules across the cell membrane. Muscle contraction is dependent upon the presence of calcium, sodium, and potassium. Without sufficient levels of these key electrolytes, muscle weakness or severe muscle contractions may occur.

Evaporative cooling takes place when sweat evaporates from the skin. High humidity reduces the rate of evaporation and thus reduces the effectiveness of the body's primary cooling mechanism.

Metabolic heat is a by-product of the body's activity.

Radiation is the transfer of heat energy through space. A worker whose body temperature is greater than the temperature of the surrounding surfaces radiates heat to these surfaces. Hot surfaces and infrared light sources radiate heat that can increase the body's heat load.

Wet bulb (NWB) temperature is measured by exposing a wet sensor, such as a wet cotton wick fitted over the bulb of a thermometer, to the effects of evaporation and convection.

3.0 HEAT STRESS AND SUN OVEREXPOSURE INJURIES

3.1 Effects of Heat Stress

"Heat stress" is the total heat burden on the body from the combination of the body heat generated while working, environmental sources (air temperature, humidity, air movement, radiation from the sun or hot surfaces/sources) and clothing requirements.

Most people feel comfortable when the air temperature is between 68°F (20°C) and 80°F (27°C) and the when relative humidity ranges from 35 to 60%. When air temperature or humidity is higher, people feel uncomfortable. Such situations do not cause harm as long as the body can adjust and cope with the additional heat. Very hot environments can overwhelm the body's coping mechanisms leading to a variety of serious and possibly fatal conditions and illnesses. The progression of these conditions and illnesses, from least to most severe is heat fatigue, heat rashes, heat cramps, heat exhaustion and heat stroke.

3.1.1 Heat Rejection by the Body

The main source of heat gain is the body's own internal heat. Called metabolic heat, it is generated within the body by the biochemical processes that keep us alive and by the energy we use in physical activity. The body exchanges heat with its surroundings mainly through radiation, convection, and evaporation of sweat.

Radiation is the process by which the body gains heat from surrounding hot objects, such as hot metal machinery, furnaces or steam pipes, and loses heat to cold objects, such as chilled metallic surfaces, without contact with them. No radiant heat gain or loss occurs when the temperature of surrounding objects is the same as the skin temperature (about 95°F (35°C)).

Convection is the process by which the body exchanges heat with the surrounding air. The body gains heat from hot air and loses heat to cold air which comes in contact with the skin. Convective heat exchange increases with increasing air speed and increased differences between air and skin temperature.

Evaporation of sweat from the skin cools the body. Evaporation proceeds more quickly and the cooling effect is more pronounced with high wind speeds and low relative humidity. In hot and humid workplaces, the cooling of the body due to sweat evaporation is limited by the capacity of the ambient air to accept additional moisture. In hot and dry workplaces, the cooling due to sweat evaporation is limited by the amount of sweat produced by the body.

The body also exchanges small amounts of heat by conduction and breathing. By conduction, the body gains or loses heat when it comes into direct contact with hot or cold objects. Breathing exchanges heat because the respiratory system warms the inhaled air. When exhaled, this warmed air carries away some of the body's heat. However, the amount of heat exchanged through conduction and breathing is normally small enough to be ignored in assessing the heat load on the body.

If the body is unable to use these mechanisms successfully to reject body heat, then heat conditions and illnesses can occur.

3.1.2 Heat Fatigue

Heat Fatigue is often caused by a lack of acclimatization. A program of acclimatization and training for work in hot environments is advisable. The signs and symptoms of heat fatigue include impaired performance of skilled manual, mental, or vigilance jobs. There is no treatment for heat fatigue except to remove the heat stress before a more serious heat-related condition develops

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3.1.3 Heat Rashes

Heat rashes are the most common problem in hot work environments. Usually, heat rash appears on moist parts of the body where skin surfaces can touch, such as on the neck, under the arms, and between the legs and in areas where clothing is restrictive or tight. As sweating increases, papules (which look like tiny, pinhead-sized red pimples) are formed that can give rise to a prickling sensation. 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.

3.1.4 Heat Collapse

Also known as 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.

3.1.5 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 appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (±0.3% NaCl), 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, approximately one cup of 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.

3.1.6 Heat Exhaustion

Heat exhaustion signs and symptoms are headache, nausea, vertigo, weakness, thirst, and giddiness. Fortunately, this condition responds readily to prompt treatment. Heat exhaustion should not be dismissed lightly. Fainting or heat collapse which is often associated with heat exhaustion. 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 and can be dangerous especially if workers are 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 and when possible ice packs should be applied. Emergency services should be contacted at extension 911 whenever heat exhaustion is suspected.

3.1.7 Heat Stroke

Heat stroke is the most serious heat related disorder and occurs when the body's temperature regulation fails and body temperature rises to critical levels. The condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict. Heat stroke is a medical emergency that may result in death. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature, e.g., a rectal temperature of 41°C (105.8°F). The elevated metabolic temperatures caused by a combination of workload and environmental heat, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady, cool area and the outer clothing should be removed. The worker's skin should be wetted and air movement around the worker should be increased 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.

Emergency services should be contacted at extension 911 whenever heat stroke is suspected. 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.

3.2 Effects of Sun Overexposure

Sunlight contains ultraviolet (UV) radiation. UV Radiation has both positive and negative effects. Positive effects of UV radiation include warmth, light, photosynthesis in plants, and vitamin D synthesis in the body. UV radiation also increases moods in people and kills pathogens. However, overexposure to UV radiation has adverse health effects, including premature aging of the skin, wrinkles, skin damage, eye damage and skin cancer.

3.2.1 Skin Damage

UV-related skin disorders include actinic keratoses and premature aging of the skin. Actinic keratoses are skin growths that occur on body areas exposed to the sun. The face, hands, forearms, and the "V" of the neck are especially susceptible to this type of lesion. Although not cancerous, actinic keratoses are a risk factor for squamous cell carcinoma (see Section 3.2.4). Look for raised, reddish, rough-textured growths and seek prompt medical attention if you discover them. Chronic exposure to the sun also causes premature aging, which over time can make the skin become thick, wrinkled, and leathery. Since it occurs gradually, often manifesting itself many years after the majority of a person's sun exposure, premature aging is often regarded as an unavoidable, normal part of growing older. With proper protection from UV radiation, however, most premature aging of the skin can be avoided.

3.2.2 Eye Damage

Cataracts are a form of eye damage in which a loss of transparency in the lens of the eye clouds vision. If left untreated, cataracts can lead to blindness. Research has shown that UV radiation increases the likelihood of certain cataracts. Although curable with modern eye surgery, cataracts diminish the eyesight of millions of Americans and cost billions of dollars in medical care each year. Other kinds of eye damage include pterygium (i.e., tissue growth that can block vision), skin cancer around the eyes, and degeneration of the macula (i.e., the part of the retina where visual perception is most acute). All of these problems can be lessened with proper eye protection from UV radiation.

3.2.3 Immune System Suppression

Scientists have found that overexposure to UV radiation may suppress proper functioning of the body's immune system and the skin's natural defenses. All people, regardless of skin color, might be vulnerable to effects including impaired response to immunizations, increased sensitivity to sunlight, and reactions to certain medications.

3.2.4 Skin Cancers

Long-term overexposure to the sun can cause skin cancer. The four types of skin cancer are:

- **Melanoma**, the most serious form of skin cancer, is also one of the fastest growing types of cancer in the United States. Many dermatologists believe there may be a link between childhood sunburns and melanoma later in life. (In fact, one source reports that five doses of sunburn while you are young can double your risk of developing this deadly disease later in life.) Both long term sun exposure and sunburn cause skin cell damage, which - over time - can lead to the development of skin cancer. Outdoor workers suffer from a high incidence of squamous cell carcinoma. Severe sunburn increases your risk of developing melanoma.
- **Nonmelanoma** skin cancers are less deadly than melanomas. Nevertheless, left untreated, they can spread, causing disfigurement and more serious health problems. More than 1.2 million Americans will develop nonmelanoma skin cancer in 2000 while more than 1,900 will die from the disease. There are two primary types of nonmelanoma skin cancers. These two cancers have a cure rate as high as 95 percent if detected and treated early. The key is to watch for signs and seek medical treatment.
- **Basal Cell Carcinomas** are the most common type of skin cancer tumors. They usually appear as small, fleshy bumps or nodules on the head and neck, but can occur on other skin areas. Basal cell carcinoma grows slowly, and rarely spreads to other parts of the body. It can, however, penetrate to the bone and cause considerable damage.
- **Squamous Cell Carcinomas** are tumors that may appear as nodules or as red, scaly patches. This cancer can develop into large masses, and unlike basal cell carcinoma, it can spread to other parts of the body.

The factors that may increase the risk of skin cancer are:

- **Fair skin**. Having less pigment (melanin) in your skin provides less protection from damaging UV radiation. If you have blond or red hair, light-colored eyes, and you freckle or sunburn easily, you're much more likely to develop skin cancer than a person with darker features is.
- **A history of sunburns**. A sunburn is your body's attempt to heal itself from the sun's damaging rays. Every time you get sunburned, you damage your skin cells and increase your risk of developing skin cancer. If you had one or more severe, blistering sunburns as a child or teenager, you have an increased risk of skin cancer as an adult. Sunburns in adulthood also are a risk factor.
- **Excessive sun exposure**. Anyone who spends considerable time in the sun may develop skin cancer, especially if your skin isn't protected by sunscreen or clothing. Tanning also puts you at risk. A tan is your skin's injury response to excessive UV radiation.
- **Sunny or high-altitude climates**. People who live in sunny, warm climates are exposed to more sunlight than are people who live in colder climates. Living at higher elevations, where the sunlight is strongest, also exposes you to more radiation.
- **Moles**. People who have many moles or abnormal moles called dysplastic nevi are at increased risk of skin cancer. These abnormal moles - which look irregular and are generally larger than normal moles - are more likely than others to become cancerous. If you have a history of abnormal moles, watch them regularly for changes.

- **Precancerous skin lesions**. Having skin lesions (i.e. actinic keratoses) can increase your risk of developing skin cancer. These precancerous skin growths typically appear as rough, scaly patches that range in color from brown to dark pink. They're most common on the face, lower arms and hands of fair-skinned people whose skin has been sun damaged.
- **A family history of skin cancer**. If one of your parents or a sibling has had skin cancer, you may be at increased risk of the disease.
- **A personal history of skin cancer**. If you developed skin cancer once, you're at risk of developing it again. Even basal cell and squamous cell carcinomas that have been successfully removed can recur in the same spot, often within two to three years.
- **A weakened immune system**. People with weakened immune systems are at greater risk of developing skin cancer. This includes people living with HIV/AIDS or leukemia and those taking immunosuppressant drugs after an organ transplant.
- **Fragile skin**. Skin that has been burned, injured or weakened by treatments for other skin conditions is more susceptible to sun damage and skin cancer. Certain psoriasis treatments and eczema creams might increase your risk of skin cancer.
- **Exposure to environmental hazards**. Exposure to environmental chemicals, including some herbicides, increases your risk of skin cancer.
- **Age**. The risk of developing skin cancer increases with age, primarily because many skin cancers develop slowly. The damage that occurs during childhood or adolescence may not become apparent until middle age. Still, skin cancer isn't limited to older people. Basal cell and squamous cell carcinomas are increasing fastest among women younger than 40.

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4.0 HEAT STRESS RISK REDUCTION

4.1 General

UT Utilities heat stress prevention program involves four elements, which are:

1. Employee Training
2. Assessing Job Stress Risks
3. Assessing Employee Heat Stress Risks
4. Heat Stress Controls

4.2 Employee Training

The most important component of the UT Utilities heat stress prevention program is employee training. In addition to reading this program document, employees shall be trained regarding the risks of heat stress and how it is reduced, as well as how to recognize heat illnesses and treat them. Specific components of the training include:

- The hazards of heat stress,
- Personal precautions that can be taken to reduce heat stress (see Section 5.1),
- Predisposing factors for, danger signs of, and symptoms of heat stress conditions and illnesses (see Section 5.2),
- Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments,
- Awareness of first-aid procedures for, and the potential health effects of, heat stroke in themselves and others,
- Employee responsibilities in avoiding heat stress,
- Typical engineering and administrative controls implemented to reduce heat stress,
- Use of personal protective equipment, and
- Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs.

4.3 Assessing the Job

Supervisors are responsible for assessing every job to determine if it is likely to pose the significant heat stress. Operations involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities have a high potential for inducing heat stress in employees. Indoor operations such as electrical utilities (particularly boiler rooms) and steam tunnels are examples of UT Utilities work locations where problems can occur. Outdoor operations conducted in hot weather, such as trenching and construction, and tasks requiring workers to wear semi-permeable or impermeable protective clothing, are also likely to cause heat stress among exposed workers.

Supervisors are responsible ensuring that appropriate heat stress reduction controls are instituted (see section 3.5) whenever significant heat stress is possible. Employees are empowered to request such controls if heat stress is expected or encountered.

4.4 Assessing the Worker

Supervisors are responsible for assessing their employee's ability to perform jobs which might involve heat stress. Age, weight, degree of physical fitness, degree of acclimatization, metabolism, dehydration, use of alcohol or drugs, and a variety of medical conditions such as hypertension all affect a person's sensitivity to heat. However, even the type of clothing worn must be considered. Prior heat injury predisposes an individual to additional injury. 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 stress controls should be modified or the employee reassigned to a job without heat stress for employees identified as at risk for heat conditions or illness.

4.5 Heat Stress Controls

Heat stress controls can take the form or engineering controls, personal protective equipment (PPE) and administrative controls. The following sections provide examples of controls that might be appropriate in certain situations.

4.5.1 Engineering Controls

General ventilation dilutes hot air with cooler air. A permanently installed ventilation system usually can handle large areas or entire buildings. Portable or local exhaust systems may be more effective or practical in smaller areas.

Air treatment differs from ventilation because it reduces the temperature of the air by removing the heat, and sometimes humidity, from the air. Air conditioning is a method of air cooling which uses a compressed refrigerant under pressure to remove the heat from the air. This method is expensive to install and operate. An alternative to air conditioning is the use of chillers to circulate unpressurized cool water through heat exchangers over which air from the ventilation system is then passed. Chillers are more efficient in cooler climates or in dry climates where evaporative cooling can be used.

Local air cooling can be effective in reducing air temperature in specific areas. Two methods have been used successfully in industrial settings. One type, cool rooms, can be used to enclose a specific workplace or to offer a recovery area near hot jobs. The second type is a portable blower with built-in air chiller. The main advantage of a blower, aside from portability, is minimal set-up time.

Evaporative coolers, such as swamp coolers and Port-a-Cool units, provide cooling by vaporizing water into moving air.

Another way to reduce heat stress is to cool the employee by increasing the air flow or convection using fans, etc. in the work area. Changes in air speed can help workers stay cooler by increasing both the convective heat exchange (the exchange between the skin surface and the surrounding air) and the rate of evaporation. This does not actually cool the air so moving air must impact the worker directly to be effective. *Convective cooling is generally only effective as long as the air temperature is less than the worker's skin temperature. Increases in air speed have no effect on the body temperature of workers wearing vapor-barrier clothing.*

Heat conduction blocking methods include insulating the hot surface that generates the heat and changing the surface itself. Simple devices, such as shields, can be used to reduce radiant heat, i.e. heat coming from hot surfaces within the worker's line of sight. Polished surfaces make the best barriers, although special glass or metal mesh surfaces can be used if visibility is a problem With some sources of radiation, such as heating pipes, it is possible to use both insulation and surface modifications to achieve a substantial reduction in radiant heat.

Shields should be located so that they do not interfere with air flow, unless they are also being used to reduce convective heating. The reflective surface of the shield should be kept clean to maintain its effectiveness.

4.5.2 Personal Protective Equipment (PPE)

Reflective clothing, which can vary from aprons and jackets to suits that completely enclose the worker from neck to feet, can reduce the radiant heat reaching the worker. However, since most reflective clothing does not allow air exchange through the garment, the reduction of radiant heat must more than offset the corresponding loss in evaporative cooling. For this reason, reflective clothing should be worn as loosely as possible. In situations where radiant heat is high, auxiliary cooling systems can be used under the reflective clothing.

Auxiliary body cooling ice vests, though heavy, may accommodate as many as 72 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 tether the worker and thus permit maximum mobility. Cooling with ice is also relatively inexpensive.

Wetted clothing such as terry cloth coveralls or two-piece, whole-body cotton suits are another simple and inexpensive personal cooling technique. It is effective when reflective or other impermeable protective clothing is worn. This approach to auxiliary cooling can be quite effective under conditions of high temperature, good air flow, and low humidity.

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 are 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. Air can also be supplied directly to the suit without using a hood in three ways: by a single inlet, by a distribution tree, or by a perforated vest. In addition, a vortex tube can reduce the temperature of circulating air. The cooled air from this tube can be introduced either under the clothing or into a bubble hood. The use of a vortex tube separates the air stream into a hot and cold stream; these tubes also can be used to supply heat in cold climates. Circulating air, however, is noisy and requires a constant source of compressed air supplied through an attached air hose. This system tethers the worker and limits his or her mobility. Additionally, since the worker feels comfortable, he or she may not realize that it is important to drink liquids frequently.

4.5.3 Administrative Controls

The human body can adapt to heat exposure to some extent. This physiological adaptation is called acclimatization of acclimation. 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. Acclimatization is generally recommended for employees returning to work from absences of three or more days and new employees.

Acclimatize workers by exposing them to work in a hot environment for progressively longer periods. NIOSH (1986) suggests that workers who have had previous experience in jobs where heat levels are high enough to produce heat stress may acclimatize with a regimen shown in Table 1.

Table 1. Heat Recovery Acclimatization Regimen – Previous Exposure

Day	Percent Exposure to Heat Stress
1	50%
2	60%
3	80%
4	100%

For new workers who will be similarly exposed, the acclimatization regimen should be as shown in Table 2.

Table 2. Heat Recovery Acclimatization Regimen – New Employee

Day	Percent Exposure to Heat Stress
1	20%
2	40%
3	60%
4	80%
5	100%

Replace fluids by providing cool (50°-60°F) water or any cool liquid (except beverages containing alcohol or caffeine) to workers and encourage them to drink small amounts frequently, e.g., one cup every 20 minutes. Ample supplies of liquids should be placed close to the work area. Although some commercial replacement drinks contain salt, this is not necessary for acclimatized individuals because most people add enough salt to their summer diets.

Employees should be encouraged to drink water on a regular schedule. Employees should be aware of the risks of water intoxication, which is a potentially fatal disturbance in brain function. Persons working in high temperature and humidity run the risk of water intoxication if they drink large amounts of water over short periods for rehydration.

Use the buddy system. Ensure that co-workers watch one another for signs of heat stress.

Reduce physical demands by reducing physical exertion such as excessive lifting, climbing, or digging with heavy objects. Spread the work over more individuals, use relief workers or assign extra workers. Provide external pacing to minimize overexertion.

Provide recovery areas, such as air-conditioned enclosures and rooms, and provide intermittent rest periods with water breaks. Establish provisions for a work/rest regimen so that exposure time to high temperatures and/or the work rate is decreased.

Reschedule hot jobs for the cooler part of the day. Routine maintenance and repair work in hot areas should be scheduled for the cooler seasons of the year. When possible, outdoor work areas should be provided with coverings, such as a tarp, to provide shade.

Monitor workers who are at risk of heat stress, such as those wearing semi-permeable or impermeable clothing when the temperature exceeds 70°F, while performing strenuous tasks. Personal monitoring can be done by checking the heart rate, recovery heart rate, oral temperature, or extent of body water loss.

To check the heart rate, count pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

The recovery heart rate can be checked by comparing the pulse rate taken at 30 seconds (P1) with the pulse rate taken at 2.5 minutes (P3) after the rest break starts. The two pulse rates can be interpreted using the criteria shown in Table 3.

Table 3. Heart Rate Recovery Determination

Heart rate recovery status	P3	Difference between P1 and P3
Satisfactory recovery	≤90	
High recovery (Conditions may require further study)	>90	10
Low recovery (May indicate too much stress)	>90	<10

Check oral temperature with a clinical thermometer after work but before the employee drinks water. If the oral temperature taken under the tongue exceeds 99.7°F (37.6°C), shorten the next work cycle by one third.

Measure body water loss, by weighing the worker at the start and end of the workday. The worker's weight loss should not exceed 1.5% of total body weight in a work day. If a weight loss exceeding this amount is observed, fluid intake should increase.

4.6 Sun Overexposure Risk Reduction

4.6.1 General

There are no safe UV rays or safe suntans. Employees should be especially careful in the sun if they are susceptible to burning easily, spend a lot of time outdoors, or have any of the following physical features:

- numerous, irregular or large moles,
- freckles; fair skin; or
- blonde, red, or light brown hair.

4.6.2 Sun Risk Reduction

Employees can implement the following protections to block harmful sunrays:

- Work in the shade whenever possible.
- Cover limbs by wearing loose-fitting, long-sleeved shirts and long pants.
- Use sunscreen with a sun protection factor (SPF) of at least 30. Be sure to follow application directions on the bottle or tube.
- Wear a hat with a wide brim cap. Wide brims protect the neck, ears, eyes, forehead, nose, and scalp from sun exposure. Baseball caps do not provide equal protection.
- Wear UV-absorbent sunglasses (eye protection). Sunglasses should be labeled as blocking 99 to 100 percent of UVA and UVB radiation.
- Limit exposure during the time of day when UV rays are most intense, which is between 10 a.m. and 4 p.m.

5.0 PROTECTING AGAINST HEAT STRESS

5.1 Preventive Measures

Personal precautions that UT Utilities employees should be aware of and institute precautions when exposed to heat stress include:

a. Fluid intake: Drink 5 to 7 ounces of cool water for every 15 to 20 minutes,
b. Salt Supplements: Not recommended since too much salt can cause higher body temperature, increased thirst and nausea
c. Dress to Increase Reflection and Convection: Wear light-colored, loose-fitting, breathable clothing,
d. Reduce Ultraviolet Radiation: Work in the shade,
e. Stop the Heat Build-up: Take frequent short breaks in cool shade.
f. Reduce Metabolic Heat: Eat smaller meals before work activity.
g. Avoid Dehydrating Liquids: Don't drink caffeine and alcohol or large amounts of sugary drinks,

5.2 Risk Factors:

Factors increasing an employee's susceptibility to heat stress include:

- Being dehydrated
- Having recently consumed alcohol
- Having diarrhea or taking antidiarrheal medications,
- Being exposed to high temperatures at night,
- Fatigue,
- Improper work procedures,
- Lack of acclimatization,
- Loss of sleep,
- Being obese,
- Being over age 40,
- Taking medications that inhibit sweating, such as antihistamines, cold medicines, diruretics and some tranquilizers,
- Previous occurrence of heat stroke
- Poor physical conditioning,
- Recent immunizations (as they can cause a fever),
- Recent drug or alcohol use,

- Skin trauma, such as heat rash or sunburn),
- Use of respirators, and
- Wearing impermeable equipment, such as rubber gloves, rubber boots or Tyvek suits.

5.3 Signs of Heat Illness

UT Utilities personnel should look for indications of heat illness in themselves and others whenever exposed to heat stress. The early signs of heat illness, or specifically heat exhaustion, include:

- Headaches, dizziness, lightheadedness or fainting,
- Muscle cramps or weakness,
- Cool, clammy skin and/or excessive sweating.
- Ashen color
- Mood changes such as irritability or confusion, and
- Upset stomach or vomiting.

The more serious signs of heat stroke include:

- Dry, hot skin with no sweating,
- Mental confusion or losing consciousness, and
- Seizures or convulsions.

The following first aid measures should be implemented whenever heat stroke is suspected:

- Move the victim to a cool place. Remove heavy clothing; light clothing can be left in place.
- Immediately cool the victim by any available means. Such as placing ice packs at areas with abundant blood supply (neck, armpits, and groin). Wet towels or sheets are also effective. The cloths should be kept wet with cool water.
- To prevent hyperthermia continue cooling the victim until their temperature drops to 102 degrees Fahrenheit.
- Keep the victim's head and shoulders slightly elevated.
- **Seek medical attention immediately.** All heat stroke victims need hospitalization.
- Care for seizures if they occur.
- Do not use aspirin or acetaminophen.