Purpose

This document establishes guidelines for preventing, identifying, evaluating & controlling heat stress and preventing fatigue at applicable Trinity locations & operations.

Scope

This policy applies to all Trinity personnel, at all locations and subcontractors.

Responsibilities

The Operations Manager is responsible for the administration, interpretation, and maintenance of this document to keep it current with business conditions. The Operations Manager is also responsible for ensuring that Supervisors receive:

- Training in the prevention of heat-related injuries prior to supervising employees working in heat;
- Training in the recognition, treatment, and mitigation of heat-related injuries for when employees show signs of exposure;

Operations Supervisors are responsible for compliance with this document at the project level and to ensure these policies and procedures are deployed and utilized at the worksite levels.

Working in Hot Climates or Conditions

Normal body temperature depends upon the balance of physiological processes addressing heat production and heat loss to the surrounding environment. Under normal conditions, the body temperature is maintained at 98.6° F. This balance depends on a number of factors including: ambient temperature, humidity, physical condition, health and physical activity. Body temperatures over 100°F in otherwise healthy individuals should be viewed with concern. Body temperature is most accurately assessed using a tympanic thermometer. There are a number of actions one can take to prevent and address heat stress. They include:

- Wear light-colored clothing and use wicking materials;
- Adhere to rest cycles and take advantage of shade and air conditioning whenever possible;
- Personal cooling devices such as vests and head gear should be used when appropriate.
- Limit outdoor activities and drink lots of water or rehydration beverages; alcohol and caffeine should be avoided as they function as diuretics and increase fluid depletion.

Be aware of the symptoms of heat stress emergencies:

- Heat cramps/muscle cramps
- Profuse sweating
- Nausea and vomiting

- Dizziness
- Lack of sweating

Actions:

Get the person to a cooler place. Remove them from the heat and perform an evaluation by safety/medical personnel. Encourage water/or approved rehydration solution intake.

Heat exhaustion: Cool, moist, pale or flushed skin; heavy sweating; headache; nausea or vomiting; dizziness or exhaustion.

Get the person to a comfortable position in a cooler place. Remove or loosen clothing and apply cool, wet cloths (towels or sheets) to the entire body. If the person is conscious, give half glass of non-alcoholic, caffeine-free liquid every 15 minutes - drink slowly. Monitor carefully for changes in condition.

Heat Stress

When the body is unable to cool itself by sweating, several heat-induced illnesses such as heat stress or heat exhaustion, and the more severe heat stroke can occur. Heat stress can result in death.

Factors Leading to Heat Stress

Factors leading to heat stress include: high temperature and humidity; sun or heat; limited air movement; physical exertion; poor physical condition; some medicines; and inadequate tolerance for hot workplaces.

Preventing Heat Stress

- Know signs/symptoms of heat-related illnesses; monitor yourself and coworkers
- Block out direct sun or other heat sources
- Use cooling fans/air-conditioning; rest regularly
- Drink lots of water
- Wear lightweight, light colored, loose-fitting clothes with perspiration wicking material
- Avoid alcohol, caffeinated drinks, or heavy meals

Identifying Heat Stress

Heat Illness

Two forms of physiological response to high temperatures are recognized:

A. Elevated skin temperatures can result in pain and tissue damage.

B. Elevated body temperatures can create the associated syndromes of heat exhaustion, heat cramps, and heat stroke.

In general whenever situational factors overwhelm the body's natural heat compensation mechanism or those mechanisms are compromised, heat stress and subsequent injury illness and death may occur. Heat is dissipated and absorbed from the body using four mechanisms:

- Evaporation – by the carriage of heat in evaporating fluid on the skin (sweat, water)
- Conduction –is the transfer of thermal energy between regions of matter due to a temperature gradient (an air conditioned environment)
- Convection – by the direct transfer of heat molecule to molecule (cool bath)
- Radiation – heat transfer electromagnetically (heating the universe)

Elevated body temperatures are commonly associated with working in hot climates or in industrial jobs involving activity in hot and/or humid spaces. Cooling is accomplished initially by dilation of the blood vessels on the skin surface. This results in an increased blood flow to the skin and a subsequent increase in skin temperature, so heat either escapes more rapidly.

The second mechanism is sweating, which occurs when there is insufficient flow of blood to the skin to meet the requirements for heat loss. Evaporation of sweat is the major mechanism by which the body cools itself. Normally the rate of secretion of sweat depends upon the magnitude of the heat imbalance. Sweat not evaporated and simply dripping from the body has no real cooling value.

Sweat production results in loss of water and salt from the body. Water loss in sweat must be replaced by increased water intake. In hot environments, water intake may need to be required (8 oz/hr) because under conditions of high heat stress, the normal thirst mechanism is not adequate to bring about a voluntary replacement of water lost. Dehydration in excess of 3 liters may have serious consequences. If normal heat balance is not maintained by the mechanisms described, then a series of heat-related illnesses can develop. These are categorized below:

Heat Exhaustion

Heat exhaustion occurs as a result of the circulatory system being unable to meet the demand of cooling the body, and providing oxygen and nutrition to muscles and organs. Fainting may result. Early symptoms of heat exhaustion may include fatigue, headache, dizziness when erect, loss of appetite, nausea, abdominal distress, vomiting, shortness of breath, flushing of face and neck, pulse rate above 150 beats/min., glazed eyes, and mental disturbances, such as apathy, poor judgment, and irritability, which usually precedes fainting (syncope). Unless the individual has another illness, such as heart disease, they will usually recover promptly if removed to a cool place and permitted to lie down for a time.

Symptoms of Heat Exhaustion

- Headaches, dizziness, lightheadedness or fainting

- Weakness and moist skin
- Mood changes such as irritability or confusion
- Upset stomach or vomiting

Heat Cramps

Heat cramps are painful muscle spasms in the extremities, back, and abdomen due to water/sodium imbalance. Heat cramps are readily alleviated by intravenous administration of salt solution or by oral intake of drinking water.

Heat Stroke

Heat stroke is the most serious heat related illness. It occurs when the body is unable to cool itself, and the body temperature rises to critical levels. Tissue damage and death are possible. Skin tissue color is red, with the skin very hot and usually dry. The victim may become confused and disoriented, and may suffer loss of coordination and/or seizures. Take emergency measures to quickly reduce body temperature to avoid brain damage. This may be done by placing the patient in wet sheets and using a fan to cool them by evaporation or by immersing the person in a cold bath.

Symptoms of Heat Stroke

- Dry, hot skin with no sweating
- Mental confusion or losing consciousness
- Seizures or convulsions
- Cardiovascular collapse

What to Do for Heat-Related Injury

- Apply First Aid
- Medical consultation
- In cases of heat stroke call 9-1-1 at once

While waiting for help to arrive:

- Move the worker to a cool, shaded area
- Loosen or remove heavy clothing
- Provide cool drinking water (if tolerated)
- Fan and mist the person with water

Human Response to Heat Build-up

Acclimatization

Acclimatization is the adaptive process resulting in a reduction of the physiological response produced by a constant environmental stress.

Some of the characteristics of acclimatization to heat are as follows:

- Acclimatization begins with the first exposure, progresses rapidly and is well developed in about one week.
- Acclimatization can be induced by short, intermittent work periods in the heat for two hours daily. Resting or inactivity in the heat produces only slight acclimatization.
- Subjects in good physical condition acclimatize more rapidly and are capable of doing more work in the heat. Good physical condition, however, does not in itself confer acclimatization. Also, individuals differ widely in their ability to acclimatize.
- Acclimatization to high heat loads will enhance performance at less severe conditions, but will only provide partial benefits for more severe conditions.
- Acclimatization to heat is well retained during periods of no exposure for about one week; thereafter, acclimatization loss varies among individuals. Within about three weeks to a month, acclimatization effects are lost and hardly any traces are to be found after a few months. Staying in good physical condition helps retain acclimatization.

Some miscellaneous aspects of acclimatization deserve consideration:

- Water intake sufficient to meet water loss in the sweat and urine is essential to working and living in hot climates.
- Salt balance must be achieved for work in heat, whether acclimatized or unacclamated to working conditions and heat.

Ability to meet the stress of high heat loads decreases in older people, but moderate heat loads can be successfully handled. Obese individuals are at a disadvantage in the heat and are more likely to incur heat illness. However, obese individuals can be acclimatized. A general rule of thumb is an approved electrolyte beverage to water at a ratio of 1:2

The fully acclimatized individual, although showing no significant decrease in ability to do physical work in the heat, may still be sensitive to the heat. Some psychological effects may occur in the heat-acclimatized individual, such as the loss of mental initiative, decrease in accurate work performance the need for greater concentration to do a given task, and possible personality changes.

Control of Heat Stress

Heat stress can be evaluated to determine specific countermeasures to be employed. Measurement of the thermal environment will determine if heat stress is a potential exposure problem. If the thermal environment is clearly seen as a potential risk, the evaluation should only be performed by a competent industrial hygienist. Plant safety coordinators should contact corporate safety and health for assistance as necessary.

Supervisors must ensure personal factors that contribute to heat-related injury are taken into consideration prior to assigning tasks where there is a possibility of a heat-related injury occurring. The most common personal factors that can contribute to heat-related injuries are age, weight/fitness, drug/alcohol use, and prior heat injuries.

Control measures can be implemented if it is determined a heat stress problem exists based on reliable weather data and the exposure standards. The control methods selected can be directed toward reducing the factor(s) which contributes most significantly to the heat exposure problem. Heat stress for an individual worker will depend on the following:

- Their bodily heat production
- The number and duration of exposures
- Cooling conditions in the rest area
- The clothing worn

Employees suffering from heat illness or believing a preventative recovery period is needed, will be provided access to an area with shade that is either open to the air or provided with ventilation or cooling. Such access shall be permitted at all times.

Employees shall also have access to potable water. Where it is not plumbed or otherwise continuously supplied, it shall be provided in sufficient quantity throughout the work shift.

The control may involve modification of one or more of these factors; however, there is no universal solution to heat stress problems.

Decreasing Metabolic Rate

When a job is self-paced, workers will spontaneously limit their average work load to 30-50% of their maximum physical performance capacity. This is done by lessening their work speed or by interspersing unscheduled work breaks. Under such conditions, mechanization can increase a worker's productivity by making possible a decrease in the time needed for rest.

Modifying the Number and Duration of Exposures

Work-rest schedules have been developed for modifying the degree of heat stress. Where work must be continued, a relief team or teams can be utilized to maintain production. Although work-rest schedules can be used as a guide, workers should have the final say in regards to the perception of fatigue, faintness, or breathlessness. This should serve to end the heat exposure. It is important to terminate exposures before physical distress occurs. In general, more work can be achieved during several shorter exposures (and with less overall strain on the worker) than longer exposure periods, even if the total exposure time is the same.

The stress of hot jobs is often dependent on changes in weather. A hot spell or an unusual rise in humidity can create overly stressful conditions. In this event, non-essential tasks should be postponed or extra workers can be assigned to lessen the work load during such periods.

Modifying the Thermal Environment

The important sources of heat stress can be identified by using thermal measurements. Calculations can be made to estimate the benefits which would be achieved if the control measures suggested are implemented.

Examples:

- Solving a High Humidity Problem with Increased Ventilation.
- A more effective and permanent control technique would be to reduce the moisture content of the room air. This should be done as close to the source as possible when the source is within the room. If the source of humidity was from outside the workroom, then mechanical air conditioning would probably be required to reduce the temperature and moisture level of the room air.
- Solving a hot, dry problem with evaporative cooling.
- Solving a radiant problem with shielding.

Thermal Conditions in the Rest Area

The temperature of the rest area should be adjusted based on the temperature tolerance and magnitude of heat stress or exposure.

Clothing

Heat exposures can be regulated by appropriate clothing. Clothing should be loose fitting with many openings. Ideally it should be made of a material which wicks moisture away from the skin.