	COMPANY HEALTH AND SAFETY PROGRAM	
	Document No. 7.4	Date: August 8, 2006
	Heat / Cold Stress Program	Revision: 0

1.0 PURPOSE

The purpose of this program is to provide knowledge and use guidelines to aid in the task of controlling or reducing the hazards of heat and cold stress in the workplace for HES employee's.

2.0 SCOPE

This document applies to all divisions/departments of HES.

3.0 POLICY


Occupational heat stress disorders, cold stress injuries, and accidents must be prevented. Preventative measures will be introduced in circumstances where a heat or cold stress injury or illness may occur. If preventative measures are not found to be effective, worker monitoring and control measures will be put into effect. Supervisors will be responsible for identifying and aiding in heat and/or cold stress injury and illness prevention.

A Heat Disorders Chart, Heat Index Chart, and Windchill Index are included in this program for reference to heat and cold stress environments. Supervisors and affected personnel may use these documents accordingly.

4.0 GENERAL

Two or three employees may work at the same job, exposed to the same conditions, and even though one will be affected by the heat or cold, the others may not. Age, weight, physical fitness, metabolism, alcohol or drug abuse, and medical condition are some of the determining factors affecting a person's sensitivity to heat or cold and susceptibility to heat disorders and cold injuries.

Heat or cold induced occupational illnesses, injuries and reduced productivity occur in situations where the heat or cold load exceeds the capacities of the body to maintain normal body functions due to excessive strain in the case of heat or slowed body metabolism and even tissue damage in the case of cold. At varying levels of heat or cold stress, the employee's compensatory mechanisms will no longer be capable of maintaining body temperature at the level required for normal body functions. Because of this, the result of heat-induced or cold stress illnesses, disorders, and accidents may dramatically increase.

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The human body loses heat through radiation losses, convection, and conduction when air moves around the body and by exhalation. These heat removal methods are necessary to keep the core body temperature at a constant rate. As the human body functions, the body chemistry generates heat. The body uses the food and water ingested to generate heat, other chemicals to maintain the biosystems. All of these chemical reactions in the human body are temperature sensitive. If the core temperature of the human body varies more than 2° C, the chemistry begins to fail and the body systems can begin to fail. Part of the heat generated by the body chemistry goes to maintain the body temperature so that the chemical reactions will occur. The remainder of the heat generated is excess and is lost by the mechanisms described above.

Cold temperatures create stress on the body by reducing body temperature, causing the body to increase its efforts to produce more heat, reducing body chemical reaction rates, and destroying cells by freezing. The use of protective equipment may give the wearer a false indication of the level of cold exposure. The trunk of the body is warm but the extremities are cold and losing heat faster than expected by the employee.

5.0 HEAT STRESS

Heat stress causes reactions from four environmental factors that affect the amount of stress an employee can face in a hot environment to include: area temperature, humidity, radiant heat, and air movement. The body reacts to high external temperature by circulating blood to the skin which increases skin temperature and allows the body to give off excess heat through the skin. Sweating is another means the body removes excess heat. The normal range of oral temperatures for humans is typically 97° F to 100.5° F during working periods. The core temperature of the normal human body is approximately 98.6° F to 100.4° F. If the core temperature is greater than 105° F brain damage may occur. The skin temperature can range from 72° F to 93° F.

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur ranging from mild to fatal. The Heat Index Chart included in this program outlines air temperatures with % relative humidity giving ranges for disorders to occur by the heat index temperatures. Heat-related problems are listed below from mild to fatal:

NOTE: Employees who have heart or circulatory diseases or conditions, or those who may be on low salt diets are at high risk for heat stress problems, and should consult their physicians prior to working in hot

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environments.

Heat Rash may be caused by continuous exposure to heat and humid air aggravated by clothing. It decreases the ability to tolerate heat as well as being a nuisance. It can be prevented by resting in a cool area and allowing the skin to dry.

Heat Cramps, which are painful spasms of the muscles, are caused when employees drink large quantities of water but fail to replace their body's salt loss. Cool, electrolyte replenishing drinks are excellent beverages to prevent heat cramps.

Heat Fatigue or fainting may be a problem for one who is not acclimatized to a hot environment, even though the worker may do nothing but stand still in the heat. Victims usually recover quickly after a brief period of lying down and receiving something cool to drink. Moving around, rather than standing still, will usually reduce the possibility of fainting.

Heat Exhaustion can occur as a result of loss of fluid through sweating when an employee has not drank enough fluids or ingested enough salt or both. An employee may still sweat, but experience extreme weakness, nausea, or headache. The skin is clammy and moist, the complexion pale or flushed, and the body temperature normal or slightly elevated.

Heat Stroke is the most serious health problem for workers in hot environments and is caused by the failure of the body's internal mechanism to regulate its core temperature. Sweating stops resulting in dry skin and the body can no longer get rid of the excess heat. Signs and symptoms of a heat stroke include the following:

- Mental confusion
- Convulsions or coma
- Delirium
- Rapid pulse
- Loss of consciousness
- A body temperature of 106° F or higher
- Hot dry skin possibly red, mottled, or bluish

Victims of heat stroke will die unless treated promptly and correctly. Even while medical help is being called, the affected employee must be removed immediately to a cool area and his/her clothing soaked with cool water. Prompt first aid can prevent permanent injury to the brain and other vital organs.

6.0 IMPLEMENTATION OF HEAT STRESS PROGRAM

The following guidelines contain some of the factors which may require a heat stress program evaluation and/or program implementation:

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1. Ambient temperature;
2. Humidity;
3. Type of work required - metabolic heat generated during work activities;
4. Required work clothing - the potential for heat stress increases as the impermeability of the work clothing increases;
5. Employee symptoms and/or complaints; and
6. Employee conditioning and/or acclimatization.

Once the HES supervisor has determined that a heat stress environment exists, then heat stress preventative measures must be implemented. If the heat stress preventative measures are not successful, then worker monitoring will begin. Worker monitoring will reduce heat stress related injuries by adjusting the work/rest periods to compensate for the hot environment.

Heat stress can be measured by the Wet Bulb Globe Temperature (WBGT). The WBGT is an expression which uses the environmental temperature, the humidity, and the solar heat load to predict the equivalent heat stress on an employee. The American Conference of Governmental Industrial Hygienist's permissible heat exposure TLVs, based on the WBGT index, are listed in the ACGIH TLV book.

7.0 HEAT STRESS PREVENTION

When unacceptable levels of heat stress occur, there are generally six approaches to a solution:

1. Modify the environment;
2. Modify the clothing or equipment;
3. Modify the work practices;
4. Modify the worker by heat acclimatization;
5. Modify production with a work/rest regimen; and
6. Modify the worker's knowledge of working in a hot environment.

One or more, but not limited to the following preventive measures or controls will aid in the reduction of heat stress:

1. Provide or make available liquids for drinking. Employees should be encouraged to drink moderate amounts at each break or as needed. Most employees do not feel thirsty until they have lost 5% of their body weight.
2. Allow sufficient rest periods as needed for employees to cool down and recover from overheating.
3. Provide cooling devices to aid natural body ventilation. These devices may add weight, and their use should be balanced against worker efficiency.

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Long cotton underwear acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing.

4. Ensure that adequate shelter is available to protect personnel against heat which can decrease physical efficiency and increase the probability of an incident.
5. In extremely hot conditions rotate workers.
6. Good hygienic practices are important ranging from frequent change of clothing to daily showering or bathing.

8.0 COLD STRESS

Employees working outdoors in temperatures at or below freezing may suffer from cold stress problems. Cold stress problems include the following: frostbite, hypothermia, and even shock. Extreme cold for a short time may cause severe injury to the surface of the body, or result in generalized cooling, potentially causing death. Areas of the body which have high surface-area-to-volume ratio such as fingers, toes, and ears, are the most susceptible.

Two factors influence the development of a cold injury, ambient temperature and the wind velocity. Wind chill is used to describe the chilling effects of moving air in combination with low temperature. For example, 10° F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18° F. As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration soaked.

Frostbite occurs when crystals form either superficially or deeply in the fluids and underlying soft tissues of the skin. There are several degrees of damage from frostbite. Frostbite of the extremities can be categorized into:

Frost nip or **incipient frostbite** is characterized by suddenly blanching or whitening of skin.

Superficial frostbite occurs when skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.

Deep frostbite occurs when tissues are cold, pale, and solid, extremely serious injury.

Signs and symptoms of frostbite include the following:

- Pale and glossy skin
- Skin color changes to white or grayish yellow

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- Mental confusion
- Failing eyesight
- Respiratory failure
- Affected part feels intensely cold and numb
- Unconsciousness
- Death
- Shock

First aid procedures for frostbite include the following:

1. When possible, re-warm the affected area by immersing it in cold water and gradually warming the water between 102° F and 105° F.
2. Note: if a thermometer is not available, test the water by dipping your elbow in it, making sure that it is just above normal body temperature.
3. Re-warming by water will take 20-30 minutes and will be accompanied by increasing pain.
4. If warm water is not available, wrap the affected area with blankets or use body heat to thaw the affected part.
5. Once re-warmed, do not allow the victim to use the affected area until it has been examined by a physician.
6. Protect the affected area to keep it clean and warm.
7. Note: Thawing of superficial frostbite includes a tingling and burning sensation in the affected area, followed by a purplish or mottled color as blood circulation is restored.
8. WARNING! Once a frostbite area has been thawed, do not allow it to refreeze. This causes significant damage and typically results in amputation.
9. Never rub a frostbite area in an attempt to warm it. This action damages the tissue and can result in the formation of gangrene.

Hypothermia is the gradual cooling of the body's inner core to the extent that normal metabolism slows down. Dangerous amounts of body heat can be lost in temperatures as warm as 40° F. Symptoms are usually exhibited in five stages:

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1. Shivering;
2. Apathy, lack of feeling, sleepiness, inactive;
3. Unconsciousness, glassy stare, slow pulse, slow respiration;
4. Freezing of the extremities; and
5. Death.

First aid procedures for hypothermia include the following:

1. Provide shelter;
2. Remove any wet clothing and redress in dry clothing or blankets;
3. Provide a source of heat to warm slowly; and
4. Obtain medical assistance immediately.

Shock may occur from either extreme heat or extreme cold stress. Shock results from a depressed state of several vital body functions. During shock, the blood circulation is disturbed or even stopped due to the body's reaction to respiratory failure, profuse bleeding, severe burns, severe cold exposure, poisoning, heart attack, and other serious medical conditions. Immediate medical attention is needed as soon as possible.

9.0 ADMINISTRATIVE/ ENGINEERING CONTROLS AND PPE

Administrative controls must be instituted for employee protection when engineering controls are not practical. One example of an administrative control is limiting the work time by defining a period range based on the work, environment, and clothing requirements. Another example may be the alternation of employees in hot or cold areas limiting exposure times or increasing break periods.

A number of engineering controls, including ventilation and spot cooling by local exhaust ventilation at points of high heat activities, can be helpful. Shielding may be necessary as protection from radiant heat sources. Cooling fans can also reduce heat in hot conditions. Mechanical equipment replacing manual labor is also an alternative to heat exposure. Periodic breaks for warming up through the use of heated enclosures or heaters may be necessary in freezing temperatures.

Personal protective equipment used for cooling/warming employees is another method to control heat/cold stress. Cooling systems such as the following may be used: water-cooled garments, air-cooled garments, ice pack vests, and even wetted over-garments with evaporation taking place. Insulated clothing and even multiple layers of clothing can be used in cold conditions. One problem with the multiple layers is the decreased means of mobility.

10.0 WORK PRACTICES

Providing a period of acclimatization for new employees and those returning from

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other work activities can help reduce the risks of heat/cold stress problems. Acclimatization to the heat/cold through short exposures followed by longer periods of work in the hot/cold areas can also reduce heat/cold stress. The consumption of drinking water is important throughout the hot and cold work activities. In high heat stress areas, an employee can lose as much as one quart of liquid per hour.

Training supervisors to recognize and be able to correctly treat heat/cold stress problems is very important. Employee's physical conditions should be considered when determining their fitness for working in hot/cold areas. Older employees, obese employees, and those taking some type of prescription drug are usually at a greater risk for experiencing a heat/cold related problem.

11.0 TRAINING

Heat/cold stress training is necessary to ensure effective work practices. If employees do not understand the reasons for using appropriate work practices to prevent heat/cold stress, the chances of this program succeeding are reduced. The following topics will be covered:

1. Hazards of heat/cold stress;
2. Recognition of danger signs and symptoms;
3. First aid procedures identified;
4. Correct use of PPE and equipment;
5. Importance of fluid intake during work activities;
6. Acclimatization for new and unfamiliar employees; and
7. Review of the Heat/Cold Stress Program.

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Category & Clinical Features	Predisposing Factors	Underlying Physiological Disturbance	Treatment	Prevention
<p>Heat Rash ("Prickly Heat") Profuse tiny raised red vesicles (blister-like) on affected areas pricking sensations during heat exposure</p>	Unrelieved exposure to humid heat with skin continuously wet with unevaporated sweat	Plugging of sweat gland ducts with retention of sweat and inflammatory action	Mild drying lotions, skin cleanliness to prevent infection	Cool sleeping quarters to allow skin to dry between heat exposures
<p>Heat Cramps Painful spasms of muscles used during work (arms, legs, or abdominal); onset during or after work hours</p>	Heavy sweating during hot work; Drinking large volumes of water without replacing salt loss	Loss of body salt in sweat, water intake dilutes electrolytes, water enters muscles, causing spasm	Salted liquids by mouth, or more prompt relief by I-V infusion	Adequate salt intake with meals; in unacclimatized workers supplement salt intake at meals
<p>Heat Fatigue - Transient Impaired performance of skilled sensorimotor, mental, or vigilance tasks, in heat</p>	Performance decrement greater in unacclimatized and unskilled worker	Discomfort and physiological strain	Not indicated unless accompanied by other heat illness	Acclimatization and training for work in the heat
<p>Heat Fatigue - Chronic Reduced performance capacity, lowering of self-imposed standards of social behavior (e.g., alcoholic over-indulgence), inability to concentrate, etc.</p>	Workers at risk come from temperate climates, for long residence in tropical latitudes	Psychosocial stresses probably as important as heat stress, may involve hormonal imbalance but no positive evidence	Medical treatment for serious cases, speedy relief of symptoms on returning home	Orientation on life in hot regions (customs, climate, living conditions, etc.)
<p>Heat Exhaustion Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or hectic flush; may faint on standing with rapid thready pulse and low blood pressure; Oral temperature normal or low</p>	Sustained exertion in heat Lack of acclimatization; and Failure to replace water lost in sweat	Dehydration from deficiency of water Depletion of circulating blood volume; Circulatory strain from competing demands for blood flow to skin and to active muscles	Remove to cooler environment, rest recumbent position, administer fluids by mouth, keep at rest until urine volume indicates that water balances have been restored	Acclimatize workers using a break-in schedule for 5-7 days, supplement dietary salt only during acclimatization, ample drinking water to be available at all times and to be taken frequently during work day
<p>Heatstroke Hot dry skin usually red, mottled or cyanotic; confusion, loss of consciousness, convulsions; fatal if treatment delayed</p>	Sustained exertion in heat by unacclimatized workers; lack of physical fitness and obesity; recent alcohol intake; dehydration; individual susceptibility; and chronic cardiovascular disease	Failure of the central drive for sweating (cause unknown) leading to loss of evaporative cooling and an uncontrolled accelerating rise in temperature, there may be partial rather than complete failure of sweating	Immediate and rapid cooling by immersion in chilled water with massage or by wrapping in wet sheet with cool dry air, avoid overcooling, treat shock if present	Medical screening of workers, selection based on health and physical fitness, acclimatization for 5-7 days by graded work and heat exposure, monitoring workers during sustained work in severe heat

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°F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	121	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	129	128	134						
96	101	104	100	112	116	121	129	122					
94	97	100	102	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	125	131		
90	91	93	95	97	100	103	105	109	113	117	122	127	132
88	88	89	91	93	95	98	100	100	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	109	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

Disorders With Prolonged Exposure and/or Physical Activity

Extreme Danger	Extreme Caution
Heat stroke or sunstroke highly likely	Sunstroke, muscle cramps, and/or heat exhaustion possible
Danger	Caution
Sunstroke, muscle cramps, and/or heat exhaustion likely	Fatigue possible

Source: National Weather Service

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Actual Thermometer Reading (°F)

Wind speed in MPH	50	40	30	20	10	0	-10	-20	-30	-40
	Equivalent Temperature (°F)									
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40 mph (little added effect)	Little Danger (for properly clothed person)				Increasing Danger			Great Danger		
					(Danger from freezing of exposed flesh)					

The human body senses “cold” as a result of both air temperature and wind velocity. Cooling of exposed flesh increases rapidly as the wind velocity goes up. Frostbite can occur at relatively mild temperatures if wind penetrates the body insulation. For example, when the actual air temperature of the wind is 4.4°C (40°F) and its velocity is 48 km/h (30 mph), the exposed skin would perceive this sensation as an equivalent still air temperature of -11°C (13°F).

Source: Fundamentals of Industrial Hygiene, Third Edition, National Safety Council

