



DOCUMENT NO.: DND-IH-PRO-00069	REV. NO. 1	EFFECTIVE DATE: <u>9/29/2026</u>
TITLE: Temperature Extremes	<u>5</u> YR PERIODIC REVIEW DATE: <u>4/14/2031</u>	
	APPROVED BY DATE:	Brandon Arthur 9/24/2026 (Signature on File)

USE CATEGORY:	INFORMATION USE	Page 1 of 34
SME: Christian Horsley	Writer: Eric Hamilton	

Level 2 Administrative Procedure

Revision	Record of Issue/Revision	Affected Pages
1	Minor Revision: Updated DND-IH-PRO-00069-F01, <i>Industrial Hygiene Wet Bulb Globe Temperature (Wbgt) Survey</i> .	33

Previous Record of Issue/Revision information is available from the history files.

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1.0 PURPOSE

This procedure provides instructions for protecting personnel that are conducting routine and non-routine work activities from the hazards associated with temperature extremes in the workplace.

2.0 SCOPE AND APPLICABILITY

- 2.1** This Level 2 procedure addresses the hazards associated with temperature extremes in the workplace whether related to heat stress or cold stress.
- 2.2** This procedure applies to all Southern Ohio Cleanup Company LLC (SOCCo) employees and contracted labor resources personnel at the Portsmouth Gaseous Diffusion Plant (PORTS) for the U.S. Department of Energy (DOE).
- 2.3** Actions identified in this procedure are most appropriate for un-acclimatized workers who are physically fit. Individuals may be determined to be acclimatized based on recent exposure to heat stress conditions. Workers who become physically unfit must use extra caution when working under heat or cold stress conditions.
- 2.4** Physiological monitoring is the preferred method for monitoring heat stress at PORTS. It is conducted using heart rate monitors and/or body temperature thermometers.
- 2.5** Physiological Monitoring will be used to assess employee exposure to hazardous temperatures. It will not be utilized to assess or determine individual medical qualifications for performing work activities (i.e., fitness for duty).

Exception:

Monitoring requirements described in this procedure do not apply to Emergency Response.

3.0 GENERAL INFORMATION

None

4.0 USE REFERENCES

DND-BS-PRO-00062, *Records Management Process*

5.0 RESPONSIBILITIES

5.1 Occupational Safety and Health (OS&H) Professional

- 5.1.1** Provides direction, technical support, and administrative assistance to Supervisors for programmatic issues involving temperature extremes.
- 5.1.2** Maintains, interprets, and reviews the Temperature Extremes Program.
- 5.1.3** Recommends physiological monitoring and related equipment, as needed, for operations involving temperature extremes.

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5.1.4 Provides worker briefings upon request from management or other involved groups.

5.1.5 Sets up Wet Bulb Globe Temperature (WBGT) Instrumentation in applicable work locations when necessary.

NOTE

When physiological monitoring isn't being utilized and a workplace WBGT °F value:

- Reaches the applicable range for 25% Work/75% Rest or
- Level 4 PPE is utilized or
- Heavy/Very Heavy work is done

THEN a detailed analysis of heat stress conditions shall be performed.

5.1.6 Performs detailed analyses of heat stress conditions, if trained, and provides recommended Work/Rest schedules or suggest the use of predetermined detailed analyses in Appendices C-E when applicable.

5.1.7 Provides technical support to the Project Managers to ensure that Supervisors understand and comply with the steps to control hazards from temperature extremes.

NOTE

Individuals without a current documented determination of acclimatization shall be deemed to be un-acclimatized.

5.1.8 Completes DND-IH-PRO-00069-F02, *Heat Stress Acclimatization Determination Worksheet*, in conjunction with the worker and his/her Supervisor to document individual acclimatization for a given work week upon request.

5.2 Contract Technical Representative

5.2.1 Ensures that requirements for physiological monitoring are incorporated into contracts where applicable.

5.2.2 Ensures contractor programs meet or exceed the requirements of this procedure, and ensures the contractor performs to his program where applicable.

5.2.3 Ensures required trainings and medical surveillance are complete.

5.3 Training Professional

5.3.1 Provides temperature extremes training material and instructions to personnel who work under temperature extremes.

5.3.2 Periodically reviews and updates training, as needed, and when OS&H provides new information.

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5.4 Supervisor

- 5.4.1** Ensures workers routinely exposed to, or anticipated to be exposed to, temperature extremes are included in the annual medical surveillance program through the Job Content Worksheet, DND-IH-PDD-00008-F01.
- 5.4.2** Ensures workers routinely exposed to, or anticipated to be exposed to temperature extremes receive annual temperature extremes training.
- 5.4.3** Complete Supervisor specific Heat Stress training.
- 5.4.4** Determines the need for and provides refresher information awareness sessions to employees as appropriate.
- 5.4.5** Requests assistance, as needed, from OS&H to review, evaluate, recommend, and/or establish controls for working in temperature extremes.
- 5.4.6** Ensures controls (i.e. physiological monitoring, work/rest regimen and detailed analysis) for Temperature Extremes are implemented into work activities.
- 5.4.7** Ensure employees working under temperature extreme controls are aware of the applicable requirements (i.e. physiological monitoring expectations, work/rest regimen etc.).

5.5 Worker

- 5.5.1** Assists in identifying potential heat/cold stress conditions by reporting symptoms or concerns to supervision.

NOTE

Significant acclimatization to cold stress is not expected in the industrial environment.

- 5.5.2** Acclimatizes or adjusts oneself through gradual increases in exposure to hot environments over several days to achieve acclimatization when desired.
- 5.5.3** Practices self-determination and takes breaks, when necessary, when heart rate/oral temperature indicates, or at the end of the appropriate work period as indicated by a detailed analysis or the pre-approved work/rest (or warm-up) analyses detailed in Appendices C-E (for Heat Stress) and Appendix G, *Cold Weather Work/Warm-Up Schedule for Outside Workers*, (for Cold Stress) to prevent illness.
- 5.5.4** Attends scheduled training/information awareness sessions.
- 5.5.5** Completes annual temperature extremes training and annual medical exam.
- 5.5.6** Cooperates with prescribed controls when utilizing personal physiological monitoring.

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5.5.7 Knows how to utilize and implement physiological monitoring and/or what the prescribed work/rest regimen is for a given work evolution.

5.6 Occupational Physician

Assists supervision in determining whether employees have current (annual) medical examinations and in determining any medical restrictions from work in hot/cold environments.

5.7 Plant Shift Superintendent (PSS)

NOTE

Conditions vary from area to area and from facility to facility.
Information received from the PSS shall only be used to ascertain a general site condition report.

Provides weather surveillance and forecast information, as requested.

5.8 Contract Professional

Coordinates with OS&H to ensure that temperature extremes requirements are added to contract language.

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6.0 ACTIONS

6.1 Actions to Protect Against Heat Stress and/or Cold Stress

OS&H Professional

- 6.1.1** Evaluate work activities for variables such as air temperature, wind speed, humidity, and clothing and/or Personal Protective Equipment (PPE) being worn.
- 6.1.2** Determine threat level of heat/cold stress providing information via survey reports, site radio, and telephone or site PSS announcements.
- 6.1.3** Recommend physiological monitoring and related equipment, as needed, for personnel working under temperature extremes.

Supervisor

- 6.1.4** Ensures workers routinely exposed to, or anticipated to be exposed to, temperature extremes are included in the annual medical surveillance program through the Job Content Worksheet, DND-IH-PDD-00008-F01.
- 6.1.5** Ensure workers who are injured due to exposure to heat or cold, or who miss three or more consecutive workdays (not calendar days) due to any illness, are medically evaluated prior to returning to work in temperature extremes.
- 6.1.6** Ensure workers complete annual temperature extremes training.
- 6.1.7** Ensure employees working under temperature extreme controls are aware of the applicable requirements (i.e. physiological monitoring expectations, work/rest regimen etc.).

Occupational Physician

- 6.1.8** Conduct special medical evaluations for all employees returning from extended periods of illness prior to authorizing return to work in hot or cold environments.
- 6.1.9** Perform physical examinations annually for all employees who work under temperature extremes as indicated in the Job Content Worksheet, DND-IH-PDD-00008-F01.
 - A.** Ensure that examinations include the following:
 - A review of duties of workers who are required to work in temperatures that exceed the limits provided in Appendices C E
 - A review of previous medical history with special attention given to cardiovascular and pulmonary functions, prescriptive medicines, and illnesses related to overexposure to heat/cold
 - B.** Maintain written records of physical examinations and medical evaluations.

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- 6.1.10** Provide written notification to employees and their supervisors whenever employees are limited or restricted from work under conditions of heat/cold stress and/or physiological monitoring use.

PSS

- 6.1.11** Provide outdoor dry-bulb (DB) temperature, wind speed, and wind chill temperature, upon request, by phone or radio announcements.

Contract Technical Representative

- 6.1.12** Ensure that contractors whose workers are routinely exposed to, or are anticipated to be exposed to, temperature extremes maintain an equivalent temperature extremes program as part of their SOCCo approved project safety and health program.
- 6.1.13** Ensure contract language requires subcontractor/vendor personnel who work on a DOE site for more than 30 days in a 12-month period to be included in the medical surveillance program.
- 6.1.14** Ensure contract language requires subcontractors to provide annual training and/or information awareness sessions for individuals working in hot/cold environments. OS&H shall be specified to have oversight of the technical content.

Supervisor

- 6.1.15** Review work activities for potential exposure to temperature extremes using Appendix I, *Guidelines for Implementing Temperature Extreme Work Requirements*.

6.2 Actions to Protect Against Heat Stress

OS&H Professional

- 6.2.1** Conduct an initial job hazard analysis to identify and evaluate jobs with a potential for heat stress.
- 6.2.2** Where feasible, recommend engineering controls such as air conditioning, fans, shade, or heat shielding to protect personnel from exposure to heat stress conditions. **IF** engineering controls are not feasible, **THEN** administrative controls (i.e., worker rotation, working at cooler times) should be considered.
- 6.2.3** Recommend personal protective clothing and equipment only as supplements to engineering controls and safe work practices in limiting exposure to temperature extremes above or below recommended Threshold Limit Values (TLVs) and Action Limits.
- 6.2.4** Conduct random field checks on the implementation of the Temperature Extremes program including quantitative measurements and documentation of findings.

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6.2.5 When physiological monitoring is not utilized (or as directed by Industrial Hygiene) obtain WBGT data and document on DND-IH-PRO-00069-F01, *Industrial Hygiene Wet Bulb Globe Temperature (WBGT)*, DND-IH-PRO-00024-F04, *Industrial Hygiene Direct Reading Survey*, or equivalent:

- At the start of each work evolutions
- As conditions warrant (i.e., change in work/rest)

6.2.6 Assist supervision in determining applicable Work-Rest Regimens upon request.

NOTE

Individuals without a current documented determination of acclimatization shall be deemed to be un-acclimatized.

6.2.7 Complete DND-IH-PRO-00069-F02 in conjunction with the worker and his/her Supervisor to document individual acclimatization for a given work week upon request.

NOTE

Physiological monitoring is the preferred monitoring technique utilized at PORTS.

6.2.8 **WHEN** administrative controls such as performing work at cooler times of the day are not feasible or are ineffective in eliminating heat stress hazards, **THEN** utilize one of the following monitoring techniques listed in Step 6.2.9.

6.2.9 The following monitoring techniques may be used in conjunction with the “buddy system.”

NOTE

Work-Rest Regimens established through WBGT monitoring apply to all individuals working under the conditions in which the sampling took place.

- A.** Physiological monitoring according to Appendix H, *Physiological Monitoring for Heat Stress*.
- B.** Utilize WBGT monitoring of indoor or outdoor work/rest areas in conjunction with Appendices B F to establish a Work-Rest Regimen.

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NOTE

When physiological monitoring isn't being utilized and a workplace WBGT °F value:

- Reaches the applicable range for 25% Work/75% Rest or
- Level 4 PPE is utilized or
- Heavy/Very Heavy work is done

THEN a detailed analysis of heat stress conditions shall be performed.

- C. Complete a detailed analysis, per required training or request a trained OS&H Professional to complete.

Supervisor

- 6.2.10** Implement the hierarchy of controls (i.e., elimination, substitution, and engineering controls) when possible to limit heat stress hazards.
- 6.2.11** Complete supervisor specific Heat Stress training.
- 6.2.12** Provide heat stress awareness sessions briefings to employees who are required to work in temperatures that exceed the Action Limits provided in Appendices C–E or use Physiological Monitoring.
- 6.2.13** Obtain WBGT or other temperature extremes data (e.g., dry-bulb air temperature and percent relative humidity) for specific jobs (rest area data may also be included [see Appendices B–F]) if physiological monitoring isn't being utilized.
- 6.2.14** Ensure employees working in temperatures that exceed applicable Action Limits provided in Appendices C-E (or other Detailed Analysis) or use physiological monitoring complete annual temperature extremes training.
- 6.2.15** Ensure employees working in temperatures that exceed applicable Action Limits provided in Appendices C-E (or other Detailed Analysis) or use physiological monitoring complete annual temperature extremes medical exam.
- 6.2.16** Direct individual workers who do not have a current documented determination of acclimatization in the same manner as un-acclimatized personnel.
- 6.2.17** Implement a phase-in approach to the job so personnel gradually become acclimatized to heat stress conditions when desired.

NOTE

Beverages designed to replace essential fluids and electrolytes may also be made available.

- 6.2.18** Ensure personnel are provided with cool water to stay hydrated.

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- 6.2.19** Ensure employees working under extreme temperature controls are aware of the applicable requirements (i.e. physiological monitoring expectations, work/rest regimen etc.).
- 6.2.20** Ensure acclimatized workers who miss seven or more consecutive days of work for any reason are gradually reacclimatized to temperature extreme conditions as applicable upon returning to work in a hot environment.
- 6.2.21** **IF** personnel exhibit signs or symptoms of heat-induced illness, **THEN** ensure they report to the Occupational Physician and provide a description of the affected worker's duties, estimated exposure to environment, metabolic heat, and a description of any PPE or clothing the worker may be required to wear.

Worker

- 6.2.22** Report potential hot environments to supervision.
- 6.2.23** **IF** taking therapeutic drugs such as beta-blockers (blood pressure medication), prescribed drugs that tend to increase the discharge of urine (diuretics), or drugs that affect the central nervous system, **THEN:**
 - A.** Check with a physician prior to working in extreme temperatures.
 - B.** Provide documentation of any work restrictions relating to temperature extremes (e.g., physician's note) and current medications to the Occupational Physician.
 - C.** Closely monitor self for symptoms of heat illness.
 - D.** Report for annual medical examination when scheduled.
- 6.2.24** Pre-hydrate by drinking as much as 16 ounces of water or a beverage containing electrolytes before working in the heat.

NOTE

A general rule of thumb is one quart of fluids per hour worked when perspiring heavily.

- 6.2.25** Replenish fluids on a frequent basis such as at the end of every work cycle (breaks in work).
- 6.2.26** Avoid excessive amounts of diuretics including caffeine-containing liquids.
- 6.2.27** Follow all physiological monitoring controls.
- 6.2.28** **IF** applicable, **THEN** know what the applicable work/rest regimen is during work activities.

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Training Professional

- 6.2.29** Train employees required to work in hot environments to recognize the signs, symptoms, and hazards of heat stress. Ensure the training covers the following factors:
- Predisposing factors
 - Relevant signs and symptoms of injury and illness
 - Potential health effects and first aid measures
 - Proper work precautions
 - A description of the medical surveillance program
 - Control measures
 - A description of the methods for monitoring environmental conditions
 - A discussion of other factors which may increase a worker's susceptibility to heat (age, weight, Body Mass Index [BMI], consumption of alcohol, taking medications such as diuretics, presence of infections, pre-existing conditions, acclimatization, etc.)

6.3 Actions to Protect Against Cold Stress

OS&H Professional

- 6.3.1** Conduct an initial job hazard analysis to identify jobs with potential for cold stress.
- 6.3.2** Recommend engineering controls, where feasible, to protect personnel from exposure to cold stress conditions.
- 6.3.3** **WHEN** engineering controls are not adequate to protect personnel from cold stress, **THEN** recommend proper clothing and a work/warm-up schedule according to Appendix G.

Supervisor

- 6.3.4** Evaluate provisions for additional total body protection for personnel engaged in prolonged work performed in a cold environment at or below 39°F (4°C).
- 6.3.5** Inform employees required to perform continuous/prolonged work in ambient air temperatures of 39°F or below of the hazards associated with cold stress and on the controls being utilized for personnel protection.

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6.3.6 Ensure that personnel dress in layers to protect against cold stress according to the following guidelines:

A. Keep outer garments from becoming wet on the job.

NOTE

Use of a water-repellent outer layer (which is changed as it becomes wet) may be more appropriate for moderate and heavy workloads.

B. **IF** only light work is involved, **THEN** the outer layer of clothing may be of a type that is impermeable to water.

C. Ensure layers are easily removable to afford adaptability to varying degrees of body heat production during different levels of work.

D. Ensure external layers are capable of being temporarily vented at waist, neck, and wrist without removal to reduce perspiration wetting.

NOTE

The precautionary actions to be taken will depend on the physical condition of the worker and should be determined with the advice of the Occupational Physician.

6.3.7 Consult with the Occupational Physician for precautionary protection of workers with a higher susceptibility to cold injury. Include special considerations of one or more of the following if desired:

A. The use of extra-insulated clothing

B. A reduction in the duration of the exposure period

6.3.8 Ensure compliance with the following requirements when personnel are engaged in continuous/prolonged work in equivalent wind chill temperatures of 11°F (-12°C) or below:

A. Workers shall be under constant protective observation (buddy system or supervision).

B. The work rate should not be so high as to cause heavy sweating that will result in wet clothing. **IF** heavy work must be done, **THEN** rest periods shall be taken in heated shelters and opportunity for changing into dry clothing shall be provided.

C. Arrange the work in such a way that sitting still or standing still for long periods in the cold environment is minimized.

D. Personnel must be properly instructed in the hazards of cold stress and the controls utilized for personnel protection.

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Worker

- 6.3.9** Maintain awareness of cold stress conditions, utilizes recommended controls, and PPE.
- 6.3.10** Take warm-up breaks as needed to prevent cold-induced illness.
- 6.3.11** Reports potential cold environments to supervision.

7.0 RECORDS

7.1 Records Generated

- A.** DND-IH-PRO-00069-F01, *Industrial Hygiene Wet Bulb Globe Temperature (WBGT) Survey*
- B.** DND-IH-PRO-00069-F02, *Heat Stress Acclimatization Determination Worksheet*

7.2 Requirements

Records generated or received as a result of performing this procedure shall be managed according to DND-BS-PRO-00062, *Records Management Process*.

8.0 DEFINITIONS/ACRONYMS

8.1 Definitions

- A. Acclimatization** – A series of physiological and psychological adjustments that occur in an individual during the first week (approximate) of exposure to heat stress so that thereafter the individual has an increased capability to withstand hot working conditions. This may be accomplished with heat stress exposures of at least two continuous hours on five of the last seven days to 10 of the last 14 days. The anticipated workload and exposure time are gradually increased to 100% over that time period. For workers who have had previous experience in jobs where heat levels are high enough to produce heat stress, the regimen should be 50% (Day 1), 60% (Day 2), 80% (Day 3), and 100% (Day 4). There is very little acclimatization to cold stress.
- B. Action Limits** – WBGT exposure guidelines established for control of heat stress hazards to which it is believed that nearly all un-acclimatized workers may be repeatedly exposed day after day without adverse effect.
- C. Anti-Contamination (Anti-C)** – PPE worn to prevent contamination.
- D. Break** - Any rest from work activities including unscheduled pauses and administrative or operational waiting periods during work. These pauses in work activities may be counted as rest time when additional rest allowance must be given because of high environmental temperatures.

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- E. Buddy System** – The practice of working in pairs or groups such that individuals assigned to a job have the responsibility of watching for signs of heat/cold stress in their coworkers. Each employee is in view of or in contact with at least one other employee in the group.
- F. Cold Environment (CE)** – Any work environment with a dry bulb air temperature of 39°F or less. Special precautions are required when equivalent wind chill temperatures reach 11°F (-12°C) or below.
- G. Cold-Induced Illness** – Generally, frostbite or hypothermia resulting from loss of body heat.
- H. Cold Stress** – A workplace condition that imposes a strain on the body due to cold temperature and wind.
- I. Detailed Analysis** - An evaluation of heat stress for a given set of conditions including the status of worker acclimatization, tasks and corresponding metabolic rates, PPE, and environmental conditions in the workplace(s) and rest area. Acceptable methods and guidance for an appropriate detailed analysis (e.g., WBGT analysis, another empirical method, or a rational method) are presented in the applicable ACGIH TLV documentation for heat stress. Work/Rest schedules may be revised as the result of a detailed analysis.
- J. Diuretic** – A substance or liquid that tends to increase the discharge of urine.
- K. Dry-Bulb (DB) Air Temperature** – The ordinary DB air temperature as measured by a thermometer that has been carefully positioned so as to be shielded from radiant heat sources.
- L. Effective Temperature** – An index that is used to relate the subjective effect that the thermal environment might be expected to have on the comfort of an individual who is exposed to that environment.
- M. Frostbite** – The freezing or partial freezing of some part of the body usually an exposed extremity.
- N. Globe Temperature (GT)** – The ambient temperature as measured by a thermometer enclosed in a copper globe painted flat black on the outside. This reading is a useful indicator of the combined effect of DB temperature, air velocity, and radiant heat (infrared radiation) on the human body.
- O. Heart Rate** – The rate of heart beats detected at the finger, wrist, chest, or neck expressed in units of beats per minute (bpm). Depending upon conditions of measurement, an individual's heart rate may be classified as a (1) Sustained or (2) Recovery heart rate (see Appendix I).

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- P. Heat Cramps** - Often caused by a combination of heat and exertion that cause the body to sweat and lose water and salt. The symptoms include painful spasms of the voluntary muscles of the arms, legs, stomach, and back. For relief, drink plenty of water. Electrolytic drinks may be used for salt replenishment unless the individual has a medical restriction such as a heart condition or on a low-sodium diet.
- Q. Heat Exhaustion** - Occurs when the body loses too much water and/or salt and becomes fatigued. Its symptoms include pale clammy skin, sweating, headache, weakness, exhaustion, dizziness, and sometimes nausea or a slight fever. The treatment is generally to move the individual to a cool place, loosen clothing, replenish fluids, apply cool compresses, and allow the individual to rest.
- R. Heat Stress** – A workplace condition that arises from a variety of factors among the most important of which are the ambient temperature, the relative humidity, the level of effort required by the job, and the clothing being worn by an exposed individual. An individual who is experiencing heat-induced illness will tend to exhibit an array of measurable symptoms that can include an increased pulse rate, a greater rate of perspiration (except for heat stroke), and an increase in the individual's body temperature.
- S. Heat Stroke** - The most hazardous condition. It occurs when the body stops sweating and temperature rises. Symptoms include dry, hot, red skin, strong and rapid pulse, chills, and often confusion. It can lead to unconsciousness, and if the body isn't cooled down, brain damage and even death. **Heat stroke is a medical emergency!** Seek medical assistance until help arrives and cool the person immediately and rapidly. Do not attempt to give an unconscious victim fluid.
- T. Hot Environment** – Any combination of DB temperature, relative humidity, radiant heat, air velocity, permeable protective clothing, work activity level, and acclimatization that exceeds Wet-Bulb Globe Temperature (WBGT) TLVs listed as TLVs or Action Limits in Appendices C-E.
- U. Hypothermia** – A cold-induced illness that occurs when your body loses heat faster than it can be produced causing a dangerous body temperature below 95°F.
- V. Maximum Sustained Heart Rate** - 180 beats per minute (BPM) minus the individual's age in years.
- W. Occupational Physician** – Physician performing medical oversight of employees included in the SOCCo Occupational Health Program.
- X. Physiological Monitoring** – A basic method or methods to measure the level of an individual's heat strain in response to heat stress conditions. This includes but is not limited to heart rate monitoring and body temperature measurement. It does not include parameters which may be considered medical monitoring such as measurement of blood pressure, oxygen saturation, or cardiac rhythm.
- Y. Rest** – The discontinuance of work activities.

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- Z. Self-Determination** – Use of individual discretion in setting exposure time and pace of work in hot or cold environments. Workers are permitted to interrupt work for non-scheduled breaks through supervision when necessary to prevent adverse health effects.
- AA. Threshold Limit Value (TLV)** – Exposure guidelines established for control of temperature extreme hazards. For heat stress conditions, TLVs are WBGT values to which it is believed that nearly all acclimatized workers may be repeatedly exposed day after day without adverse effect. For cold stress conditions, TLVs are combinations of dry-bulb air temperature, wind, and sun to which it is believed nearly all workers may be repeatedly exposed day after day without adverse effect.
- BB. Wind-Chill Temperature Index** – A cold stress index that utilizes temperature and wind speed combination to estimate the cooling effect of an equivalent temperature under calm conditions.
- CC. Work-Rest Regimen** – A cycle of work time followed by rest time, generally expressed as a percentage of work in the work-rest cycle each hour for regular work patterns (continuous work), or up to two hours for irregular work patterns (intermittent work) that can be repeated throughout a work shift. For example, cycle of “50% Work / 50% Rest” indicates a cycle of 30 minutes work followed by 30 minutes of rest during each hour for continuous work or 60 minutes work followed by 60 minutes of rest every two hours for intermittent work during the work shift. Regular work patterns involve relatively homogeneous exposures during work-rest periods that are repeated several times over the length of the shift. It also includes normal morning and afternoon breaks (~15 minutes each) and a longer lunch break (~30 minutes). Irregular work patterns involve significant changes in exposure during a single work-rest period and/or an irregular pattern of work-rest periods over the length of the shift.
- DD. Wet Bulb Globe Temperature Index (WBGT)** – A measurement that approximates “effective temperature” and takes into account virtually all the commonly accepted mechanisms of heat transfer (radiant, evaporative, convective, conductive, etc.). Because of its simplicity, WBGT has been adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) as its principal index for use in specifying heat stress related Threshold Limit Values and Action Limits. The WBGT is computed according to the following algebraic sums:
- $WBGT_{\text{Outdoors}} = 0.7 [\text{natural wet bulb}] + 0.2 [\text{globe temperature}] + 0.1 [\text{dry bulb temperature}]$
 - $WBGT_{\text{Indoors}} = 0.7 [\text{natural wet bulb}] + 0.3 [\text{globe temperature}]$

8.2 Acronyms

- A. ACGIH** – American Conference of Governmental Industrial Hygienists
- B. BMI** – Body Mass Index

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- C. CFR** – Code of Federal Regulations
- D. DB** – Dry-Bulb
- E. DOE** – Department of Energy
- F. ESH&Q** – Environmental Safety Health and Quality
- G. GT** – Globe Temperature
- H. MSHR** – Maximum Sustained Heart Rate
- I. OS&H** – Occupational Safety and Health
- J. PSS** – Plant Shift Superintendent
- K. PPE** – Personal Protective Equipment
- L. SOCCo** – Southern Ohio Cleanup Company
- M. TLV** – Threshold Limit Values
- N. TWA** – Time Weighted Average
- O. WBGT** – Wet Bulb Globe Temperature

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Appendix A
SOURCE REFERENCES AND REGULATORY REQUIREMENTS

1. 10 CFR 851, *Worker Safety and Health Program*
2. ACGIH, *Threshold Limit Values (TLV) for Chemical and Physical Agents* (2016 and latest editions)
3. DND-IH-PDD-00008, *Fitness for Duty*
4. National Institute for Occupational Safety and Health (NIOSH). *Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments*. Publication No. 2016-106, (2016)
5. US National Institute for Occupational Safety and Health (NIOSH): *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. Publication No. 85-115. (1985)

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Appendix B

WORK GUIDE FOR SELECTION OF METABOLIC RATE CATEGORIES AND CLOTHING ADJUSTMENT FACTORS USED TO DETERMINE HEAT STRESS WORK-REST REGIMENS

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Appendices C – E enable selection of Work-Rest Regimens for un-acclimatized workers in both indoor and outdoor areas when physiological monitoring is not used. Activities must be evaluated by using the following Work Guide to determine the appropriate metabolic rate category of work being performed. The metabolic rate category is used in conjunction with the PPE level and WBGT °F measurements in the workplace and rest areas to identify corresponding Action Limits and Work-Rest Regimens in Appendix C, D, or E (whichever is applicable).

In order to determine Work-Rest Regimens for acclimatized personnel, i.e., workers with an approved DND-IH-PRO-00069-F02 the Action Limits in Appendices C – E may be increased by 4.1 °F (or >4.1 °F if derived by a detailed analysis). Individuals without a current approved acclimatization determination worksheet shall be deemed un-acclimatized.

Physiological monitoring is the preferred monitoring technique, however IF not utilized then WBGT-based Work-Rest Regimens and/or other detailed analysis may be used in lieu of physiological monitoring.

Work Guide – Examples of Activities Within Metabolic Rate Categories			
Light Work	Moderate Work:	Heavy Work	Very Heavy Work
Sitting performing light manual work with hands, arms, and legs Driving Standing at machine or bench doing mostly light arm work (e.g., using table saw) Occasional walking (Generally can be performed indefinitely with ease)	Sustained moderate hand, arm, and leg work Moderate arm and trunk work Light pushing and pulling (e.g. scrubbing in a standing position) Normal walking (Generally can be performed indefinitely with some effort)	Intense arm and trunk work (e.g., manual sawing) Carrying Shoveling Pushing and pulling heavy loads Non-continuous heavy assembly work Intermittent heavy lifting with pushing and pulling (e.g., manual pick and shovel work) Walking at a fast pace (Generally can be performed for about 30 minutes before a break)	Very intense activity at fast to maximum pace Shoveling wet sand Calisthenics (Generally can be performed for about 15 minutes before a break)
Estim. Avg = 180 Watts	Estim. Avg = 300 Watts	Estim. Avg = 415 Watts	Estim. Avg = 520 Watts
Clothing Adjustment Factors (CAFs) (WBGT °F) For PPE Levels In Appendices C - E			
Level 1 = 0°F	Level 2 = 7.2°F	Level 3 = 12.6°F	Level 4 = 19.8°F

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Appendix B

WORK GUIDE FOR SELECTION OF METABOLIC RATE CATEGORIES AND CLOTHING ADJUSTMENT FACTORS USED TO DETERMINE HEAT STRESS WORK-REST REGIMENS

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The Action Limits for continuous work provided in Appendices C - E are based on the condition that there are conventional rest periods with short morning and afternoon breaks (approximately 15 minutes each) and a longer lunch break (approximately 30 minutes). In addition, rest periods include any break in work activities including unscheduled pauses and administrative or operational waiting periods during work. These pauses in work activities may be counted as rest time when additional rest allowance must be given because of high environmental temperatures.

The Action Limits provided in Appendix C are based on the condition that breaks are taken with outer PPE removed (to the knees) in a rest area having the same WBGT °F as the work area.

The Action Limits provided in Appendix D are based on the condition that the rest area is cooled (e.g., air-conditioned) to a WBGT of 68°F. These Action Limits may be applied for conservative results whenever the rest area WBGT is less than or equal to 68°F. However, when the rest area WBGT exceeds 68°F, Action Limits for corresponding Work-Rest Regimens may be determined by monitoring WBGT °F and time spent in the work and rest areas, calculating the time-weighted average (TWA) WBGT °F with the following formula, and using Appendix C to identify the corresponding Work-Rest Regimen:

$$\text{Average Temp (WBGT)} = \frac{\text{Temp}(1) \times t(1) + \text{Temp}(2) \times t(2) + \text{Temp}(n) \times t(n)}{t(1) + t(2) + \dots + t(n)}$$

Where Temp(1), Temp(2), ... and Temp(n) are temperature readings (WBGT) for the various work and rest areas occupied during total time periods, and t(1), t(2), and t(n), are the elapsed times in minutes spent in the corresponding areas.

The Action Limits provided in Appendix E are based on the condition that rest breaks are taken in the same PPE (undoffed) and WBGT °F as the work area.

Appendix F presents estimated WBGT °F equivalents of Dry Bulb Air Temperature and Percent Relative Humidity for conversion to/from WBGT °F in the absence of radiant heat. For example, Appendix F lists Dry Bulb Air Temperature and percent Relative Humidity combinations of 127°F @ 0%RH, 116°F @ 10%RH, and 88°F @ 90%RH as estimated equivalents for 87°F WBGT.

Consult an OS&H Professional for assistance in evaluating and monitoring work activities as needed.

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Appendix C
WBGT°F HEAT STRESS ACTION LIMITS FOR UN-ACCLIMATIZED PERSONNEL REST
BREAKS IN PPE LEVEL 1 (OR EQUIVALENT) IN ENVIRONMENT W/SAME WBGT°F AS
WORK AREA

PPE Level 1 - One Pair Coveralls or Scrubs (e.g., Typical Blue or Beige), Gloves, Shoe Covers				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 82.5	≤ 76.9	-----	-----
75% Work/25% Rest	82.6 - 83.6	77.0 - 78.8	≤ 75.6	-----
50% Work/50% Rest	83.7 - 84.7	78.9 - 81.0	75.7 - 78.3	≤ 76.3
25% Work/75% Rest	84.8 - 86.0	81.1 - 83.8	78.4 - 82.0	76.4 - 80.5

PPE Level 2 - Add One Pair Anti-Cs (e.g., Cloth or Permeable Tyvek) and/or Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 75.4	≤ 69.7	-----	-----
75% Work/25% Rest	75.5 - 78.2	69.8 - 73.3	≤ 70.1	-----
50% Work/50% Rest	78.3 - 81.1	73.4 - 77.4	70.2 - 74.7	≤ 72.7
25% Work/75% Rest	81.2 - 84.2	77.5 - 81.9	74.8 - 80.1	72.8 - 78.7

PPE Level 3 - Add Second Pair Anti-Cs (e.g., Cloth or Permeable Tyvek), Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 69.9	≤ 64.3	-----	-----
75% Work/25% Rest	70.0 - 74.1	64.4 - 69.3	≤ 66.1	-----
50% Work/50% Rest	74.2 - 78.4	69.4 - 74.7	66.2 - 72.0	≤ 70.0
25% Work/75% Rest	78.5 - 82.9	74.8 - 80.6	72.1 - 78.8	70.1 - 77.4

PPE Level 4 - Limited-Use Vapor Barrier Coveralls (e.g., Impermeable Tyvek), Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 62.7	≤ 57.1	-----	-----
75% Work/25% Rest	62.8 - 68.7	57.2 - 63.9	≤ 60.7	-----
50% Work/50% Rest	68.8 - 74.8	64.0 - 71.1	60.8 - 68.4	≤ 66.4
25% Work/75% Rest	74.9 - 81.1	71.2 - 78.8	68.5 - 77.0	66.5 - 75.6

Note: When the workplace WBGT °F value reaches the applicable range for 25% Work/75% Rest, Level 4 PPE or greater is worn, or Heavy/Very Heavy work is performed physiological monitoring or a detailed analysis of heat stress conditions shall be performed. Contact an OS&H Professional for a detailed analysis and revised Work/Rest schedule when personnel do not utilize physiological monitoring.

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Appendix D

WBGT °F HEAT STRESS ACTION LIMITS FOR UN-ACCLIMATIZED PERSONNEL REST BREAKS IN PPE LEVEL 1 (OR EQUIVALENT) IN COOL ENVIRONMENT W/WBGT 68°F OPTIONAL USE: REST BREAKS IN PPE LEVEL 1 (OR EQUIVALENT) IN COOL ENVIRONMENT W/WBGT <68°F

PPE Level 1 - One Pair Coveralls or Scrubs (e.g., Typical Blue or Beige), Gloves, Shoe Covers				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 82.5	≤ 76.9	-----	-----
75% Work/25% Rest	82.6 - 88.8	77.0 - 82.3	≤ 78.0	-----
50% Work/50% Rest	88.9 - 101.5	82.4 - 94.0	78.1 - 88.6	≤ 84.6
25% Work/75% Rest	101.6 - 107.6	94.1 - 100.0	88.7 - 94.6	84.7 - 90.7

PPE Level 2 - Add One Pair Anti-Cs (e.g., Cloth or Permeable Tyvek) and/or Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 75.3	≤ 69.7	-----	-----
75% Work/25% Rest	75.4 - 81.6	69.8 - 75.1	≤ 70.8	-----
50% Work/50% Rest	81.7 - 94.3	75.2 - 86.8	70.9 - 81.4	≤ 77.4
25% Work/75% Rest	94.4 - 100.4	86.9 - 92.8	81.5 - 87.4	77.5 - 82.9

PPE Level 3 - Add Second Pair Anti-Cs (e.g., Cloth or Permeable Tyvek), Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 69.9	≤ 64.3	-----	-----
75% Work/25% Rest	70.0 - 76.2	64.4 - 69.7	≤ 65.4	-----
50% Work/50% Rest	76.3 - 88.9	69.8 - 81.4	65.5 - 76.0	≤ 72.0
25% Work/75% Rest	89.0 - 95.0	81.5 - 87.4	76.1 - 82.0	72.1 - 78.1

PPE Level 4 - Limited-Use Vapor Barrier Coveralls (e.g., Impermeable Tyvek), Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 62.7	≤ 57.1	-----	-----
75% Work/25% Rest	62.8 - 69.0	57.2 - 62.5	≤ 58.2	-----
50% Work/50% Rest	69.1 - 81.7	62.6 - 74.2	58.3 - 68.8	≤ 64.8
25% Work/75% Rest	81.8 - 87.8	74.3 - 80.2	68.9 - 77.4	64.9 - 76.0

Note: When the workplace WBGT °F value reaches the applicable range for 25% Work/75% Rest, Level 4 PPE or greater is worn, or Heavy/Very Heavy work is performed physiological monitoring or a detailed analysis of heat stress conditions shall be performed. Contact an OS&H Professional for a detailed analysis and revised Work/Rest schedule when personnel do not utilize physiological monitoring.

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Appendix E
WBGT°F HEAT STRESS ACTION LIMITS FOR UN-ACCLIMATIZED PERSONNEL
REST BREAKS IN SAME PPE LEVEL AND WBGT°F AS WORK AREA

PPE Level 1 - One Pair Coveralls or Scrubs (e.g., Typical Blue or Beige), Gloves, Shoe Covers				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 82.5	≤ 76.9	-----	-----
75% Work/25% Rest	82.6 - 83.6	77.0 - 78.7	≤ 75.5	-----
50% Work/50% Rest	83.7 - 84.7	78.8 - 81.0	75.6 - 78.3	≤ 76.3
25% Work/75% Rest	84.8 - 86.0	81.1 - 83.7	78.4 - 81.9	76.4 - 80.5

PPE Level 2 - Add One Pair Anti-Cs (e.g., Cloth or Permeable Tyvek) and/or Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 75.3	≤ 69.7	-----	-----
75% Work/25% Rest	75.4 - 76.4	69.8 - 71.5	≤ 68.3	-----
50% Work/50% Rest	76.5 - 77.5	71.6 - 73.8	68.4 - 71.1	≤ 69.1
25% Work/75% Rest	77.6 - 78.8	73.9 - 76.5	71.2 - 74.7	69.2 - 73.3

PPE Level 3 - Add Second Pair Anti-Cs (e.g., Cloth or Permeable Tyvek), Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 69.9	≤ 64.3	-----	-----
75% Work/25% Rest	70.0 - 71.0	64.4 - 66.1	≤ 62.9	-----
50% Work/50% Rest	71.1 - 72.1	66.2 - 68.4	63.0 - 65.7	≤ 63.7
25% Work/75% Rest	72.2 - 73.4	68.5 - 71.1	65.8 - 69.3	63.8 - 67.9

PPE Level 4 - Limited-Use Vapor Barrier Coveralls (e.g., Impermeable Tyvek), Respirator, Hood				
Work/Rest Schedule	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	≤ 62.7	≤ 57.1	-----	-----
75% Work/25% Rest	62.8 - 63.8	57.2 - 58.9	≤ 55.7	-----
50% Work/50% Rest	63.9 - 64.9	59.0 - 61.2	55.8 - 58.5	≤ 56.5
25% Work/75% Rest	65.0 - 66.2	61.3 - 63.9	58.6 - 62.1	56.6 - 60.7

Note: When the workplace WBGT °F value reaches the applicable range for 25% Work/75% Rest, Level 4 PPE or greater is worn, or Heavy/Very Heavy work is performed physiological monitoring or a detailed analysis of heat stress conditions shall be performed. Contact an OS&H Professional for a detailed analysis and revised Work/Rest schedule when personnel do not utilize physiological monitoring.

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Appendix F

WBGT (°F) EQUIVALENTS FOR SELECTED DRY BULB AIR TEMPERATURE (°F) AND RELATIVE HUMIDITY (%) ESTIMATED FOR INDOOR AREAS W/O RADIANT HEAT

Indoor WBGT	0% DB °F	10% DB °F	20% DB °F	30% DB °F	40% DB °F	50% DB °F	60% DB °F	70% DB °F	80% DB °F	90% DB °F	100% DB °F
60	81	77	74	71	69	67	65	64	62	61	60
61	83	78	75	72	70	68	66	65	63	62	61
62	84	80	76	74	71	69	67	66	64	63	62
63	86	81	78	75	72	70	68	67	65	64	63
64	88	83	79	76	74	71	70	68	66	65	64
65	89	84	80	77	75	73	71	69	67	66	65
66	91	86	82	79	76	74	72	70	68	67	66
67	92	87	83	80	77	75	73	71	69	68	67
68	94	89	84	81	78	76	74	72	70	69	68
69	96	90	86	82	80	77	75	73	71	70	69
70	97	92	87	84	81	78	76	74	72	71	70
71	99	93	88	85	82	79	77	75	74	72	71
72	101	94	90	86	83	81	78	76	75	73	72
73	103	96	91	87	84	82	79	77	76	74	73
74	104	97	92	89	85	83	81	78	77	75	74
75	106	99	94	90	87	84	82	80	78	76	75
76	108	100	95	91	88	85	83	81	79	77	76
77	109	102	96	92	89	86	84	82	80	78	77
78	111	103	98	94	90	87	85	83	81	79	78
79	113	105	99	95	91	88	86	84	82	80	79
80	115	106	100	96	93	90	87	85	83	81	80
81	116	108	102	97	94	91	88	86	84	82	81
82	118	109	103	98	95	92	89	87	85	83	82
83	120	110	104	100	96	93	90	88	86	84	83
84	122	112	106	101	97	94	91	89	87	85	84
85	124	113	107	102	98	95	93	90	88	86	85
86	126	115	108	103	100	96	94	91	89	87	86
87	127	116	110	105	101	97	95	92	90	88	87
88	129	118	111	106	102	99	96	93	91	89	88
89	131	119	112	107	103	100	97	94	92	90	89
90	133	121	113	108	104	101	98	96	93	91	90
91	135	122	115	110	105	102	99	97	94	92	91
92	137	124	116	111	107	103	100	98	95	93	92
93	139	125	117	112	108	104	101	99	96	94	93
94	140	127	119	113	109	105	102	100	97	95	94
95	142	128	120	114	110	106	103	101	98	96	95
96	144	129	121	116	111	108	105	102	99	97	96
97	146	131	123	117	112	109	106	103	101	98	97
98	148	132	124	118	114	110	107	104	102	99	98
99	150	134	125	119	115	111	108	105	103	100	99
100	152	135	127	121	116	112	109	106	104	101	100
101	154	137	128	122	117	113	110	107	105	102	101
102	156	138	129	123	118	114	111	108	106	103	102
103	158	140	130	124	119	115	112	109	107	105	103
104	160	141	132	125	120	117	113	110	108	106	104
105	162	143	133	127	122	118	114	111	109	107	105
106	164	144	134	128	123	119	115	112	110	108	106
107	166	146	136	129	124	120	116	113	111	109	107
108	168	147	137	130	125	121	118	115	112	110	108
109	170	148	138	131	126	122	119	116	113	111	109
110	172	150	140	133	127	123	120	117	114	112	110
111	174	151	141	134	129	124	121	118	115	113	111
112	176	153	142	135	130	125	122	119	116	114	112
113	178	154	143	136	131	127	123	120	117	115	113
114	180	156	145	138	132	128	124	121	118	116	114
115	182	157	146	139	133	129	125	122	119	117	115
116	184	159	147	140	134	130	126	123	120	118	116
117	186	160	149	141	136	131	127	124	121	119	117
118	188	162	150	142	137	132	128	125	122	120	118
119	190	163	151	144	138	133	129	126	123	121	119
120	192	165	153	145	139	134	130	127	124	122	120

Note: Determine WBGT equivalent by finding row for DB temperature in applicable %RH column. %RH shall be rounded conservatively

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Appendix G
COLD WEATHER WORK/WARM-UP SCHEDULE FOR OUTSIDE WORKERS

TLVs Work/Warm-up Schedule for Outside Workers based on a Four-Hour Shift*											
Air Temperature - Sunny Sky		No Noticeable Wind		Wind 8 km/h (5 mph)		Wind 16 km/h (10 mph)		Wind 24 km/h (15 mph)		Wind 32 km/h (20 mph)	
°C (approx)	°F (approx)	Max. work Period	No. of Break s**	Max. Work Period	No. of Break s	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm breaks) 1		(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20°to -24°	(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to -34°	-25°to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease					
-40° to -42°	-40°to -44°	30 min.	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease									

Wind Chill Chart (ACGIH 2016)									
Estimated Wind MPH	Actual Shielded Dry-Bulb Thermometer Reading - °F								
	40	30	20	10	0	-10	-20	-30	-40
	Wind Chill Temperature - °F								
0	40	30	20	10	0	-10	-20	-30	-40
5	37	27	16	6	-5	-15	-26	-36	-47
10	28	16	4	-9	-24	-33	-46	-58	-70
15	22	9	-5	-18	-32	-45	-58	-72	-85
20	18	4	-10	-25	-39	-53	-67	-82	-96
25	16	0	-15	-29	-44	-59	-74	-88	-104
30	13	-2	-18	-33	-48	-63	-79	-94	-109
35	11	-4	-20	-35	-51	-67	-82	-98	-113
40	10	-6	-21	-37	-53	-69	-85	-100	-116

Little Danger of Frostbite. Wind chill Temperatures Above -25°F

Moderate Danger of Frostbite. Wind chill Temperatures - 25°F or Below

Great Danger of Frostbite. Exposed Flesh May Freeze Within 30 Seconds. Wind chill Temperatures Below -73°F

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Appendix H
PHYSIOLOGICAL MONITORING FOR HEAT STRESS
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This appendix is intended to be used to ensure workers maintain safe heart rates and body temperatures under conditions of heat stress. Not all individuals are affected by heat in the same way. An individual's response to working in a hot environment depends on a variety of factors (i.e., level of physical fitness, age, gender, level of acclimatization, use of alcohol and drugs, etc.).

Physiological monitoring measures an individual's response to heat, determining their heat load and acts as a method of preventing overexposure. Physiological monitoring is the preferred monitoring technique in heat-related work environments. The monitoring shall be performed by the worker or another qualified individual. This will allow personnel to adjust the work/rest regimen according to their individual tolerance for heat.

WARNING

Any time symptoms of sudden fatigue, nausea, dizziness, or lightheadedness manifest themselves, the individual shall discontinue work immediately and report for medical evaluation.

Physiological monitoring may result in a more restrictive or less restrictive work period for individuals with a low tolerance to heat stress. Physiological monitoring may be conducted using one or more of the following methods outlined on Pages 2 and 3 of this Appendix.

Data obtained during Physiological Monitoring (i.e., Heart Rate) will not be retained in Industrial Hygiene Records.

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Heart Rate Monitoring (OS&H can provide or recommend heart rate monitors)

NOTE

During time in which heart rate is being determined ensure work activities are in a safe configuration

Sustained Heart Rate (3 Minutes) Monitoring (e.g., measured during work with a heart rate monitor such as a wristwatch, chest strap or pulse oximeter.)

Determine heart rate during work by using a heart rate monitor. Discontinue any environmentally-induced or activity-induced heat stress for an individual when the heart rate is greater than the value representing 180 beats per minute (bpm) minus the individual's age in years (this is their Maximum Sustained Heart Rate-MSHR). Work may resume when an individual's heart rate is below 180 bpm minus the individual's age in years. This limit only applies to healthy adults with assessed normal cardiac performance. Workers having a resting heart rate in excess of 120 bpm shall be referred to the Occupational Physician for evaluation.

If an individual's sustained heart rate is greater than their MSHR then the work activity shall be stopped, the individual shall move to a cooler area, and Supervision and OS&H shall be consulted for additional actions.

Heart rate monitoring shall be conducted prior to work start (resting heart rate) and after each 15- minute work period unless performed continuously using heart rate monitors that are programmed to notify the worker or qualified individual (e.g. audible or vibrating alarm) when their MSHR is reached. If reliant on an alarm it is important to ensure the type of alarm can be heard or felt by the individual based on the scope of work.

An evaluation of the type of heart rate monitor shall be performed to ensure it is and adequate for the job scope. For example using a wristwatch heart rate monitor unequipped with an alarm set at 180 minus individuals age in years would not be suitable for use under PPE that is taped at the wrists and relying on an audible alarm for alert would not be suitable if working with loud equipment or wearing hearing protection. Common types of HR monitors used at PORTS are listed below;

- Wristwatch– useful if in an area where PPE does **NOT** obstruct the wrist.
- Chest strap/watch combination – useful if wearing PPE that obstructs the wrist.
- Pulse Oximeters – useful if wearing PPE that obstructs the wrist and chest strap cannot be worn.

In all cases the type of monitor needs to be evaluated to ensure it is practical for the job scope and type of PPE. Contact OS&H for ANY concerns, questions or recommendations for heart rate monitors.

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Appendix H
PHYSIOLOGICAL MONITORING FOR HEAT STRESS
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Body Temperature (Work/Rest Period) (OS&H can provide or recommend oral thermometers)

NOTE

Oral temperature readings may not be applicable for some job scopes (i.e. in an area where respiratory protection is required). In these cases other monitoring techniques must be used.

IF measuring body temperature using an oral thermometer, **THEN**, to ensure an accurate temperature reading is taken ensure the following requirements are met:

- Individual has not ingested food or drink for 15 minutes prior to the reading
 - Mouth is kept CLOSED during the reading
- A. Measure body temperature at any time during the work period or as soon as possible in the rest period. The body temperature shall not be allowed to stay over 99.5°F (100.4°F, if medically approved and fully acclimatized).
- i. If temperature exceeds 99.5°F (100.4°F), shorten next work cycle by 1/3 and keep rest period the same. This effectively increases the overall rest time.
 - ii. If temperature exceeds 99.5°F (100.4°F) at the beginning of the next rest period, shorten the next work cycle by 1/3 and keep rest period the same.
 - iii. Continue until body temperature is at or below 99.5°F (100.4°F) at the beginning of the next rest period.
- B. Temperature monitoring should be conducted approximately every 15 minutes when the applicable TLVs or Action Limits of Appendices C - E are exceeded or when workers self-determine that monitoring is appropriate.
- C. Length of rest periods times are not dictated by this procedure, but need to be long enough to allow body temperatures to return to pre-start levels.

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Temperature Extremes

Appendix I

GUIDELINES FOR IMPLEMENTING TEMPERATURE EXTREME WORK REQUIREMENTS

When dry-bulb air temperatures are $\geq 80^{\circ}\text{F}$ or $\leq 39^{\circ}\text{F}$ or when heat stress increasing conditions have been identified for the work activity (using layered or impermeable PPE, undertaking heavy or very heavy work activities) supervisors shall ensure the use of physiological monitoring, WBGT environmental work/rest based monitoring or a detailed analysis. Supervisors shall contact their OS&H Professional for evaluations, monitoring, and recommendations of heat/cold stress controls including temperature measurements and work-rest regimens or physiological monitoring (heart rate or body temperature), as well as for guidance regarding engineering controls, administrative work practices and PPE. Engineering and Administrative controls shall be planned for and prepared in advance of work activities if possible. Other conditions warranting an evaluation for temperature extremes include expressions of concern among workers and symptoms such as excessive fatigue or sweating or shivering to a significant extent during the job.

Supervisors shall contact OS&H and/or Radiation Protection, Fire Protection, Nuclear Criticality Safety, environmental, and other appropriate organizations for assistance and direction in completing job hazard analyses, permits, safety and health plans, procedures, and other command media where there is a potential for heat/cold stress.

Initial hazard screening for temperature extremes are to be documented by means of operating procedures/instructions, permits, job hazard analyses, pre-job briefings, safety and health plans, or other media. Hazard screening will also need to assure that the work is performed in accordance with recommendations, written guidance, or permits approved by OS&H and Radiation Protection.

The following screening criteria have been derived based on published ACGIH 2016 Action Limits and may be compared with actual or estimated workplace WBGT $^{\circ}\text{F}$ measurements to assist in the evaluation of heat stress conditions when physiological monitoring isn't being performed:

Screening Criteria for Heat Stress Exposure (WBGT $^{\circ}\text{F}$) Unacclimatized Personnel (PPE Level 1)				
Work Demands	Light	Moderate	Heavy	Very Heavy
Continuous 100% Work	≤ 82.6	≤ 77.0	-----	-----
75% Work 25% Rest	82.7 – 83.6	77.1 – 78.8	≤ 75.6	-----
50% Work 50% Rest	83.7 – 84.8	78.9 – 81.0	75.7 – 78.3	≤ 76.3
25% Work 75% Rest	84.9 – 86.1	81.1 – 83.8	78.4 – 82.0	76.4 – 80.6

- WBGT values are expressed to the nearest 0.9°F (0.5°C), and represent thresholds when work and rest environments have the same WBGT $^{\circ}\text{F}$. Examples of corresponding Action Limits are presented in Appendices C and E for rest periods in PPE Level 1 or the working PPE Level, respectively.
- If work and rest environments are different, hourly time-weighted averages (TWA) WBGT $^{\circ}\text{F}$ should be calculated and used. An example utilizing a resting WBGT of 68°F in PPE Level 1 is presented in Appendix D. TWAs for work rates should also be used when the work demands vary within the hour.
- Values in the table assume 8-hour workdays in a 5-day workweek with conventional breaks. When workdays are extended, consult an OS&H professional.
- Because of the physiological strain associated with Heavy and Very Heavy work among less fit workers regardless of WBGT, criteria values are not provided for continuous work and for up to 25% Rest in an hour. The screening criteria are not recommended, and a detailed analysis and/or physiological monitoring shall be used.
- If utilizing a supplied air “bubble hood” and Level 4 PPE over Level 1 PPE then the Level 3 PPE chart in Appendices C-E may be used. Contact OS&H for questions.

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Appendix J HEAT STRESS DETAILED ANALYSIS

NOTE: Personnel must be formally trained to utilize a detailed analysis spreadsheet.

Detailed analysis evaluations of heat stress for a given set of conditions includes; status of worker acclimatization, tasks and corresponding metabolic rates PPE and environmental conditions in the workplace and rest area.

Acceptable methods and guidance for an appropriate detailed analysis (e.g., WBGT analysis, another empirical method, or a rational method) are presented in the applicable ACGIH TLV documentation for heat stress. Work/Rest schedules may be revised as the result of a detailed analysis. Only trained personnel may complete a heat stress detailed analysis utilizing the spreadsheet. If utilizing other detailed analysis methods it must be documented and approved by the OS&H Department Manager

WBGT Exposure Assessment Based on Documentation for 2016 ACGIH TLVs & Action Limits														
Heat Stress Detailed Analysis - Calculation of ACGIH WBGT TLVs (Acclimatized) & Action Limits (Unacclimatized)														
Data Entry: Enter Data/Notes in Yellow Highlighted Cells Starting With Loc/Task 1. Reset Data By Right-Clicking "Clear Contents" for WBGT _{rest} °F & Minutes Under Loc/Tasks. CAFs and Watts May Be Changed, if needed.														
Data	Loc/Task 1	Loc/Task 2	Loc/Task 3	Loc/Task 4	Loc/Task 5	Rest Area		PPE Level	CAF (°F)	Workload	Watts Acclim	Watts Unacclim		
PPE Level	1	1	1	1	1	1		1	0	Rest	115	115		
Workload Metabolic Rate	Light	Light	Light	Light	Light	Rest		2	7.2	Light	180	180		
WBGT _{rest} °F								3	12.6	Moderate	300	300		
Work Minutes						Calculated		4	19.8	Heavy	415	415		
										Very Heavy	520	520		
Total Working Minutes for Loc/Tasks 1 - 5						0.0								
TWA Working WBGT (°F) for Loc/Tasks 1 - 5						#DIV/0!								
TWA Working Clothing Adjustment Factor (CAF) for Loc/Tasks 1 - 5						#DIV/0!								
TWA Working WBGT + CAFs (°F) for Loc/Tasks 1 - 5						#DIV/0!								
TWA Working Watts for Acclimatized Performing Loc/Tasks 1 - 5						#DIV/0!	#DIV/0!							
TWA Working Watts for Unacclimatized Performing Loc/Tasks 1 - 5						#DIV/0!	#DIV/0!							
Acclimatized Personnel														
Total Work Minutes	Calc. Rest Minutes		Total Work/Rest Minutes		Work/Rest % / %									
0	W/R Not Calc		W/R Not Calc		W/R Not Calc									
Minutes Total Work/Rest Cycle for Acclimatized						W/R Not Calc	Exceeds 2Hr TWA							
WBGT °F Effective Exposure For Acclimatized						W/R Not Calc								
TWA Watts Metabolic Rate for Acclimatized						W/R Not Calc								
Estimated Equivalent WBGT °F TLV for Acclimatized Personnel						W/R Not Calc								
Unacclimatized Personnel														
Total Work Minutes	Calc. Rest Minutes		Total Work/Rest Minutes		Work/Rest % / %									
0	W/R Not Calc		W/R Not Calc		W/R Not Calc									
Minutes Total Work/Rest Cycle for Unacclimatized						W/R Not Calc	Exceeds 2Hr TWA							
WBGT °F Effective Exposure For Unacclimatized						W/R Not Calc								
TWA Watts Metabolic Rate for Unacclimatized						W/R Not Calc								
Estimated Equivalent WBGT °F Action Limit for Unacclimatized						W/R Not Calc								
Notes:														
Completed By (PRINT/SIGN/DATE):												Heat Stress Detailed Analysis, Rev.4.1 For Use With FBP-IH-PRO-00069		

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Attachment A
INDUSTRIAL HYGIENE WET BULB GLOBE TEMPERATURE (WBGT) SURVEY



Survey Number: DND-IH-

INDUSTRIAL HYGIENE Wet Bulb Globe Temperature (WBGT) SURVEY							
Administrative Information							
Date:	Facility:	Location:	Project:	Page Number _____ of _____			
JHA#:	Job Description:			Job Supervisor:			
Instrument Information							
Instrument	I.D./Serial Number	Current Calibration	Calibration Due Date	Battery Check			
		☐ Yes ☐ No		☐ Pass ☐ Fail ☐ N/A (Plugged In)			
		☐ Yes ☐ No		☐ Pass ☐ Fail ☐ N/A (Plugged In)			
		☐ Yes ☐ No		☐ Pass ☐ Fail ☐ N/A (Plugged In)			
		☐ Yes ☐ No		☐ Pass ☐ Fail ☐ N/A (Plugged In)			
Results							
Time	Sampling Location	Indoor or Outdoor	WBGT (°F)	Reference Appendix	Work Activity Level*	PPE Level*	Work/Rest Regimen*
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A
		☐ Indoor ☐ Outdoor		☐ C ☐ D ☐ E ☐ N/A	☐ Lgt ☐ Mod ☐ Hvy ☐ V.Hvy	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Cont ☐ 75/25 ☐ 50/50 ☐ 25/75 ☐ 0A

Note: When monitoring criteria indicates a highlighted selection, physiological monitoring or a detailed analysis is required.

Comments/Calculations:

Monitoring Performed by (print/sign):	Badge:	Date:
Monitoring Performed by (print/sign):	Badge:	Date:

DND-IH-PRO-00069- F01, Rev. 1 Reviewed By (initials): Date:

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Attachment B

HEAT STRESS ACCLIMATIZATION DETERMINATION WORKSHEET



Heat Stress Acclimatization Determination Worksheet

Name of Worker: _____ Badge Number: _____ Work Week Beginning: _____

Previous Work Date	Bldg./Location	Work Activities Under Heat Stress Conditions (Total Exposure Time Must Be ≥2 Hrs./Day)	Exposure To Heat (Hrs.)	Estimated Work Activity Level (Circle)	PPE Level (Circle)	WBGT °F During Activity (Avg. or Range)
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	
				L M H VH	1 2 3 4	

- To be completed by an OS&H Professional in conjunction with the Worker and his/her Supervisor, preferably at the beginning of the work week
- Descriptors for Work Activity Levels Are As Follows: L = Light M = Moderate H = Heavy VH = Very Heavy
- Worker must be medically qualified, trained and not be restricted from heat stress related work
- To be considered acclimatized for purposes of the TLV, individual must be exposed to Heat Stress Conditions ≥2 Hrs./Day during 5 of the last 7 or 10 of the last 14 days; qualifying exposures pertain to time spent under applicable Work-Rest Regimens for non-continuous work

Final Determination of Heat Stress Acclimatization for Work Week Specified Above (Circle): Yes No

Worker Signature/Badge No: _____ / _____ Date: _____

Supervisor Signature/Badge No: _____ / _____ Date: _____

OS&H Professional/Badge No: _____ / _____ Date: _____