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CP3-HS-2000 FRev. 2	**TITLE**: Temperature Extremes	**Page 1 of 30**

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REVISION/CHANGE LOG

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FR 0	Bluesheet Initial Release	All	10/20/2017
FR 1	Nonintent Changes to Remove From Bluesheet	All	12/07/2017
FR 2	Clarification of existing and incorporation of new steps throughout	All	9/06/2018

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1.0 PURPOSE AND SCOPE

1.1 Purpose

This procedure defines the actions and monitoring requirements when work is performed in temperature extremes. Temperature extremes include hot or cold environments. The procedure is designed to protect employees in accordance with the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) for Chemical and Physical Agents by implementing appropriate engineering controls, administrative controls, and/or personal protective equipment (PPE). Additional information for implementing temperature extreme work requirements is outlined in Appendix D, *Guidelines for Implementing Temperature Extreme Work Requirements*.

1.2 Scope

This procedure applies to all work activities that, based on hazard analysis, have the potential for temperature extremes performed by the Paducah Gaseous Diffusion Plant (PGDP) Deactivation and Remediation (D&R) Project or its subcontractors. The action steps outlined in this procedure are required when the ACGIH TLVs for heat or cold stress are met or exceeded. A decision-making flow diagram for heat stress control options is outlined in Appendix H, *Heat Stress Control Options Decision-Making Diagram*. Emergency response activities are not included within the scope of this procedure.

2.0 REFERENCES

2.1 Use References

- CP2-SM-1000, *Activity Level Work Planning and Control Program*
- CP3-HS-2004, *Job Hazard Analysis*
- CP3-HS-4002, *Implementation of the Occupational Medicine Program*

2.2 Source References

- *ACGIH Threshold Limit Values (TLV) for Chemical and Physical Agents* (latest edition)
- DHHS (NIOSH) Publication No. 2016-106, Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments (Revised Criteria 2016)
- Title 10 Code of Federal Regulations (CFR) § 851, *Worker Safety and Health Program*

3.0 COMMITMENTS

None

4.0 RESPONSIBILITIES

4.1 Supervisor

- Ensures employees are acclimated to temperature extremes.
- Ensures Physiological forms are completed.
- Ensures work-rest regimens are followed or physiological monitoring is performed, when required.

4.2 Safety and Health Personnel/Industrial Hygiene

- Provides subject matter expert for CP3-HS-2000, *Temperature Extremes*.
- Approves temperature extreme forms.
- Obtains Wet Bulb Globe Temperature (WBGT) readings and logs information on forms.

4.3 Employee

- Immediately reports any symptoms attributed to temperature extremes to their supervisor.
- Completes temperature extreme forms.
- Completes Acclimation Schedule Log.

4.4 Medical Service Provider

- Determines what personnel can be exposed to temperature extremes
- Maintains a list of personnel that have been prescribed medications which could have an impact on their work performance involving temperatures extremes (ex. Alpha and Beta Blockers).

5.0 GENERAL INFORMATION

5.1 Employees have the right and responsibility to exit a hot or cold work environment regardless of an established work schedule or physiological indicators if they feel they may be experiencing signs or symptoms of heat or cold illness.

5.2 Employees shall immediately report any symptoms attributed to temperature extremes to their supervisor.

5.3 Work-rest regimens established through physiological monitoring are specific for each individual. Work situations in which physiological monitoring is utilized to exceed the work-rest regimen limits listed in Appendix B must be conducted using the Buddy System. Refer to Appendix C, *Physiological Monitoring for Heat Stress*, for additional guidance and information.

5.4 Physiological monitoring may be used:

- To validate employee recovery and support return-to-work following a rest period.
- To modify work-rest regimens to adjust for individual variation, personal cooling PPE, or other factors.

5.5 Physiological monitoring is required in the following situations:

- In any circumstance where the effective WBGT exceeds the maximum heat stress limits (25/75 work-rest) in Appendix B, *Work-Rest Regimens for Heat Stress*, Tables 4, 5, or 6 for acclimated employees or Tables 7, 8, or 9 for un-acclimated employees;
- **When** work-rest regimens cannot be practically imposed;
- **When** fully encapsulated PPE invalidates the Heat Stress tables;
- **When** vapor barrier (impermeable: for example Tychem 2000) whole-body clothing is worn in a hot environment where the effective WBGT exceeds any of the heat stress limits in Appendix B, *Work-Rest Regimens for Heat Stress*, Tables 4, 5, or 6 for acclimated employees or Tables 7, 8, or 9 for un-acclimated employees.

5.6 Heart rate monitors have been evaluated and approved by Safety and Health/Industrial Hygiene (S&H/IH) Personnel to provide physiological measurements during work. The manufacturers' instructions shall be used as an aid for setting up, donning, and maintaining heart rate monitors.

5.7 Supervisor must ensure that individuals assigned to work in environments that increase the potential for development of heat or cold stress fully understand the potential safety hazards and requirements for work in temperature extremes. Safety topics and/or flash bulletins that communicate temperature extreme hazards, controls, and requirements should be discussed during pre-shift briefings in periods of extreme temperatures.

5.8 Periods without water or rest shall not exceed 120 minutes for employees subject to physiological monitoring. **If** the conditions of a hot environment are **NOT** met, **then** this time limit does **NOT** apply.

5.9 Work activities may be suspended by S&H/IH Personnel when the effective WBGT exceeds 90° Fahrenheit (F). An evaluation of the work activities and controls will be done prior to resuming work.

5.10 Prior to performing work in a hot environment, medical approval is required according to CP3-HS-4002, *Implementation of the Occupational Medicine Program*.

5.11 Certain medications may affect an employee's heart rate and/or ability to work in temperature extremes. Consultation with the PGDP Medical Service Provider (MSP) is needed in these circumstances. It is important to discuss specific types and doses of medication with the MSP during the annual physical and whenever medications or dosage changes. This will help the MSP evaluate employees' ability to work in temperature extremes.

5.12 In case of a medical emergency contact Plant Shift Superintendent (PSS) by one of the following:

- CALL PSS Emergency Phone—333 (Bell) or 555 (PAX)
- USE Radio—TURN knob to position 16; CALL for Alpha 1. State "Emergency Traffic, Emergency Traffic"
- CALL PSS Office—6211, STATE "This is an Emergency"
- CALL from a cell phone (270) 441-6333

6.0 INSTRUCTIONS

6.1 Heat Exposure Controls

Supervisor

6.1.1 Based on scope of work and anticipated environmental conditions at the work location, Implement the controls to protect employees from heat stress as described in the hazard analysis in accordance with CP2-SM-1000, *Activity Level Work Planning and Control Program.*

S&H/IH Personnel

NOTE: Symptoms of heat exposure illness are outlined in Appendix E, *Signs and Symptoms of Heat Illnesses.*

6.1.2 Provide technical support **and** make recommendations to protect employees from temperature extremes.

6.1.3 Monitor environmental parameters to determine if the screening criteria for heat stress action limits as established in Appendix B, *Work-Rest Regimens for Heat Stress*, will be exceeded.

Supervisor

6.1.4 Evaluate the implementation of engineering controls such as, air conditioning, fans, shade, or heat shielding to protect personnel from exposure to heat stress conditions.

NOTE:

Protective clothing and equipment are only used as supplements to engineering controls and safe work practices in maintaining exposure to temperature extremes below applicable limits.

6.1.5 **If** engineering controls are **NOT** adequate or feasible, **then** protect employees by implementing protective measures including an appropriate work-rest regimen, physiological monitoring, and/or PPE requirements as established by S&H/IH.

NOTE:

Employees should be encouraged to drink small volumes (approximately 1 cup or 8 ounces) of cool, palatable water or other acceptable fluid replacement drink about every 20 minutes.

6.1.6 Provide an adequate supply of cool water or other electrolyte replenishing liquid during temperature extremes.

Employee

6.1.7 Participate in work planning to help identify activities with the potential for heat stress hazards.

6.1.8 Work according to work control documents and protective measures (work-rest regimens, physiological monitoring, PPE) that have been implemented for the site or task.

6.1.9 Take work breaks according to any applicable work-rest regimen or as necessary to prevent heat related illnesses.

6.1.10 Replenish fluids on a frequent basis; **and** avoid alcohol and excessive caffeine consumption.

NOTE:

Specific dose and types of medication do **NOT** need to be discussed with your supervisor.

6.1.11 Notify supervision of any changes in medication, both prescription and over-the-counter.

Supervisor

6.1.12 **If** a fit-for duty evaluation is necessary, **then** notify the MSP **and** direct the worker to report to the onsite medical facility.

6.2 Acclimatization to Temperature Extremes

NOTE:

Acclimatization is a gradual physiological adaptation that improves an individual's ability to tolerate heat stress. Acclimatization requires physical activity under heat-stress conditions similar to those anticipated for the work. Allow employees to become acclimatized to the heat by slowly increasing the duration of work over a period of time (for example, five to seven days). The loss of acclimatization begins when the activity under those heat stress conditions is discontinued, and a noticeable loss occurs after 4 days and may be completely lost in 3 to 4 weeks.

Heat stress controls are based on the assumption that employees are acclimated and are physically fit. An employee's initial exposure to a heat stress environment represents a dynamic period of adjustment. Employees who lose acclimatization or fitness must exercise prudence when returning to work and re-acclimate themselves appropriately to heat stress conditions. As such, the acclimatization period should be at least as closely monitored as ongoing temperature extremes work with acclimatized personnel.

Supervisor

NOTE:

Unless the following steps are followed and documentation is available, employees shall be considered un-acclimated.

6.2.1 Allow un-acclimated employees an acclimatization period by either of the following:

- Adjusting the work schedule (50% on the first day, 60% on the second day, 80% on the third day, and 100% on the fourth day) established from Appendix B, Tables 4, 5, and 6 for acclimated workers**.**
- The use of physiological monitoring as described in Sections **6.4, 6.5, 6.6**.

6.2.2 Allow four days of heat exposure to gain acclimatization in **NO** more than seven calendar days.

6.2.3 Document the employee's acclimatization status on CP3-HS-2000-F03, *Acclimatization Schedule Log*. Enter the employee's name, the date, and either the adjusted work time or the time worked while using physiological monitoring.

6.2.4 **Prior** to assigning work in a hot environment where work-rest regimens are used, review CP3-HS-2000-F03 **and** verify the employee has been acclimated.

6.2.5 Re-acclimate employees who miss seven or more consecutive days of work.

6.3 Establishing Work-Rest Regimens Using WBGT

NOTE:

The WBGT can be used as the principal index for use in environmental monitoring for specifying a heat stress related TLV. The WBGT offers a useful first-order index of the environmental contribution to heat stress.

Section **6.3** is **NOT** to be followed if any of the conditions in Section **5.5** are met, physiological monitoring is required.

S&H/IH Personnel

NOTES:

Work-rest regimens established through environmental monitoring apply to all individuals.

6.3.1 Perform WBGT environmental monitoring in accordance with Appendix B, *Work-Rest Regimens for Heat Stress*, to evaluate heat stress conditions and establish a work-rest regimen that is applicable to employees under the conditions in which the monitoring took place.

6.3.2 **If** employees have been acclimated to elevated temperatures according to Section **6.2**, **then** follow the work-rest regimens found in Appendix B, Tables 4, 5, and 6.

6.3.3 Use Appendix B, Tables 7, 8, and 9 for un-acclimated workers that do **NOT** routinely work in hot environments (such as, support groups, vendors, visitors) and due to their exposure frequency will not become acclimatized.

6.3.4 Record WBGT environmental monitoring results on form CP3-HS-2000-F02, *WBGT Direct Reading Log*.

Supervisor

6.3.5 Implement the established work-rest regimen according to the tables for acclimated or un-acclimated employees in Appendix B for the work being performed.

S&H/IH Personnel

6.3.6 Provide technical guidance to Supervisor for implementing work-rest regimens.

6.3.7 Evaluate the effectiveness of the established work-rest regimens in reducing the effects of heat stress.

6.4 Physiological Heart Rate Monitoring with personal wearable display

NOTE:

S&H/IH may utilize wireless heart rate transmitters and receivers (for example, Heart Rate monitor and tablet) to provide supplemental heat stress monitoring.

Supervisor

NOTE:

Action steps should be performed sequentially unless otherwise noted.

6.4.1 Ensure CP3-HS-2000-F01, *Physiological Heart Rate Monitoring Form* is available for employees prior to beginning work.

Employee

NOTE:

To prevent interferences between heart rate monitors it is recommended that employees be at least 3 feet away from each other when initially starting to record heart rate measurements. It is also recommended that the transmitter electrodes are moistened prior to donning the transmitter and that the transmitter has a tight fit around your chest.

6.4.2 Perform a pre-use inspection of heart rate monitoring equipment to ensure the equipment is functioning properly, the target heart rate is set, and the alarm (such as, audible or vibration) is turned on.

6.4.3 Record name, badge number, and target heart under the Employee Information section on CP3-HS-2000-F01.

6.4.4 Record pre-work heart rate under the Pre-Work Heart Rate section on CP3-HS-2000-F01.

6.4.5 Ensure all information is accurate and legible.

6.4.6 **If** pre-work heart rate measurements exceed 110 beats per minute (bpm), **then** do **NOT** begin work. Contact your Supervisor or S&H/IH personnel.

6.4.7 Record the time entered into the hot environment in the time in block on CP3-HS-2000-F01.

6.4.8 During work activities, periodically check the personal wearable display to ensure the target heart rate is not exceeded.

6.4.9 **If** target heart rate is exceeded, **then** temporarily pause work activities to determine if heart rate remains elevated or begins to drop.

6.4.10 **If** the target heart rate is exceeded and remains elevated for two or more minutes, **then immediately** exit the work area **and** notify Supervisor or S&H/IH Personnel.

6.4.11 **When** exiting the hot environment, record the time exited in the time out block on CP3-HS-2000-F01.

NOTE:

The post-work heart rate must be taken 1-2 minutes into the rest period.

6.4.12 Record the post-work heart rate in the heart rate block on CP3-HS-2000-F01.

6.4.13 Record the total work time in minutes on CP3-HS-2000-F01.

6.4.14 **If** post-work heart rate exceeds 110 bpm, **then** notify Supervisor or S&H/IH Personnel.

Supervisor

6.4.15 **Prior** to the next work period, verify that each employee's monitoring result is logged on the form(s) and is legible.

6.4.16 **Prior** to the next work period, determine the need for an adjusted work schedules based on post-work physiological monitoring results by shortening the total work time in minutes by one-third and keeping the rest period the same. Refer to Appendix C.

6.4.17 Document the adjusted work schedule on CP3-HS-2000-F01.

6.4.18 **Prior** to the next work period, notify all affected employees of adjusted work schedules.

6.4.19 Review, sign, **and** provide completed CP3-HS-2000-F01 to S&H/IH Personnel by the end of the shift.

S&H/IH Personnel

6.4.20 Obtain sample numbers for pre and post work monitoring results and record on the sample number block on CP3-HS-2000-F01.

6.4.21 Review **and** sign completed CP3-HS-2000-F01.

6.4.22 Forward a copy of the completed CP3-HS-2000-F01 to the MSP.

MSP

6.4.23 Review physiological monitoring data provided **and** evaluate to determine an individual's response to heat stress conditions.

6.4.24 Communicate any restrictions or limitations for an individual working in temperature extremes to the appropriate Supervisor and the Human Resources (HR) department.

6.5 Physiological Heart Rate Monitoring without personal wearable display

Supervisor

NOTE:

Action steps should be performed sequentially unless otherwise noted.

Due to potential S&H/IH resource limitations or work place layout/location interferences, use of wireless receivers (such as, tablets) may **NOT** be appropriate. This determination will be made by the S&S/IH representative.

6.5.1 Ensure CP3-HS-2000-F01, *Physiological Heart Rate Monitoring Form,* is available for employees prior to beginning work.

Employee

NOTE:

To prevent interference between heart rate monitors it is recommended that employees be at least 3 feet away from each other when initially starting to record heart rate measurements. It is also recommended that the transmitter electrodes are moistened prior to donning the transmitter and that the transmitter has a tight fit around your chest.

6.5.2 Perform a pre-use inspection of heart rate monitoring equipment to ensure the equipment is functioning properly.

6.5.3 Record name, badge number, and target heart under the Employee Information section on CP3-HS-2000-F01.

6.5.4 Ensure all information is accurate and legible.

S&H/IH Personnel

6.5.5 Ensure the wireless heart rate transmitters and receivers (for example, Heart Rate monitor and tablet) are working properly.

6.5.6 Ensure the target heart rate is entered for each worker.

6.5.7 Record pre-work heart rate under the Pre-Work Heart Rate section on CP3-HS-2000-F01.

6.5.8 **If** pre-work heart rate measurements exceed 110 beats per minute (bpm), **then** notify the worker **NOT** to begin work **and** contact the worker's Supervisor.

Employee

6.5.9 Record the time entered into the hot environment in the time in block on CP3-HS-2000-F01.

S&H/IH Personnel

6.5.10 Perform continuous monitoring of the workers' heart rates on the wireless receiver (such as, tablet)

6.5.11 **If** target heart rate is exceeded, **then** notify the worker to temporarily pause work activities to determine if heart rate remains elevated or begins to drop.

6.5.12 **If** the target heart rate is exceeded and remains elevated for two or more minutes, **then immediately** notify the worker to exit the work area **and** notify the worker's Supervisor.

Employee

6.5.13 **When** exiting the hot environment, record the time exited in the time out block on CP3-HS-2000-F01.

6.5.14 Record the total work time in minutes on CP3-HS-2000-F01.

S&H/IH Personnel

NOTE:

The post-work heart rate must be taken 1-2 minutes into the rest period.

6.5.15 Record the post-work heart rate in the heart rate block on CP3-HS-2000-F01.

6.5.16 **If** post-work heart rate exceeds 110 bpm, **then** notify the Supervisor.

6.5.17 **Prior** to the next work period, verify that each employee's monitoring result is logged on the form(s) and is legible.

6.5.18 **Prior** to the next work period, determine the need for an adjusted work schedules based on post-work physiological monitoring results by shortening the total work time in minutes by one-third and keeping the rest period the same. Refer to Appendix C.

6.5.19 Document the adjusted work schedule on CP3-HS-2000-F01 **and** notify the workers' supervisor.

Supervisor

6.5.20 Review **and** sign CP3-HS-2000-F01.

6.5.21 **Prior** to the next work period, notify all affected employees of adjusted work schedules.

S&H/IH Personnel

6.5.22 Obtain sample numbers for pre and post work monitoring results **and** record on the sample number block on CP3-HS-2000-F01.

6.5.23 Review **and** sign completed CP3-HS-2000-F01.

6.5.24 Forward a copy of the completed CP3-HS-2000-F01 to the MSP.

MSP

6.5.25 Review physiological monitoring data provided **and** evaluate to determine an individual's response to heat stress conditions.

6.5.26 Communicate any restrictions or limitations for an individual working in temperature extremes to the appropriate Supervisor and the Human Resources (HR) department.

6.6 Physiological Pre and Post Work Pulse Rate or Body Temperature Monitoring

NOTE:

Action steps should be performed sequentially unless otherwise noted.

Non-real time physiological monitoring frequency shall not exceed the work cycle determined by the work-rest regimen established in Step **6.6.1** and shall **NOT** exceed 15 minutes when the maximum WBGT TLV is exceeded in the 25/75 Work/Rest row of the tables in Appendix B.

S&H/IH Personnel

6.6.1 Perform WBGT environmental monitoring **and** establish a work-rest regimen as described in Steps Error! Reference source not found. through **6.3.4**.

6.6.2 Record the work period as the physiological monitoring frequency in the corresponding comment section of form CP3-HS-2000-F02, *WBGT Direct Reading Log*.

6.6.3 Communicate WBGT and physiological monitoring frequency time to the applicable supervisor.

Supervisor

6.6.4 Ensure approved pulse rate monitoring devices and body temperature monitoring devices are working properly and available at the job site.

6.6.5 Record physiological monitoring frequency provided by S&H/IH, in the comments section of CP3-HS-2000-F01, *Physiological Heart Rate Monitoring Form,* or CP3-HS-2000-F04, *Physiological Temperature Monitoring Form*.

6.6.6 Ensure the applicable Form CP3-HS-2000-F01, *Physiological Heart Rate Monitoring Form,* or CP3-HS-2000-F04 is available for employees prior to beginning work.

6.6.7 Inform the workers of the physiological monitoring frequency time.

Employee

6.6.8 Record name and badge number under the Employee Information section on CP3-HS-2000-F01 or CP3-HS-2000-F04.

Supervisor

NOTE:

Steps **6.6.9** – **6.6.11** may be delegated by the Supervisor to a designee who is trained in the use of approved pulse rate and body temperature monitoring devices.

6.6.9 Obtain workers' pre work pulse rates or pre-work body temperature **and** record under the applicable section of CP3-HS-2000-F01 or CP3-HS-2000-F04.

6.6.10 Ensure all information is accurate and legible.

6.6.11 **If** pre-work pulse rate measurements exceed 110 beats per minute (bpm) or pre-work body temperature exceeds 99.4°F, **then** do **NOT** allow the employee to begin work.

Employee

6.6.12 Record the time entered into the hot environment in the time in block on CP3-HS-2000-F01 or CP3-HS-2000-F04.

6.6.13 Ensure non-real time physiological monitoring (pulse rate or body temperature) is recorded under the applicable section of CP3-HS-2000-F01 or CP3-HS-2000-F04 at the physiological monitoring frequency time provided by the supervisor. Start a new line entry as necessary.

6.6.14 **When** exiting the hot environment, record the time exited in the time out block on CP3-HS-2000-F01 or CP3-HS-2000-F04.

Supervisor

NOTE: The post-work pulse rate or body temperature must be taken 1-2 minutes into the rest period.

6.6.15 Record the post-work pulse rate or body temperature in the applicable block on CP3-HS-2000-F01 or CP3-HS-2000-F04.

6.6.16 Record the total work time in minutes on CP3-HS-2000-F01 or CP3-HS-2000-F04.

6.6.17 **Prior** to the next work period, verify that each employee's monitoring result is logged on the form(s) and is legible.

6.6.18 **Prior** to the next work period, determine the need for an adjusted work schedules based on post-work physiological monitoring results by shortening the total work time in minutes by one-third and keeping the rest period the same. Refer to Appendix C.

6.6.19 Document the adjusted work schedule on CP3-HS-2000-F01 or CP3-HS-2000-F04.

6.6.20 **Prior** to the next work period, notify all affected employees of adjusted work schedules.

6.6.21 Review, sign, **and** provide completed CP3-HS-2000-F01 or CP3-HS-2000-F04 to S&H/IH Personnel by the end of the shift.

S&H/IH Personnel

6.6.22 Obtain sample numbers for pre and post work monitoring results **and** record on the sample number block on CP3-HS-2000-F01 or CP3-HS-2000-F04.

6.6.23 Review **and** sign completed CP3-HS-2000-F01 or CP3-HS-2000-F04.

6.6.24 Forward a copy of the completed CP3-HS-2000-F01 or CP3-HS-2000-F04 to the MSP.

MSP

6.6.25 Review physiological monitoring data provided **and** evaluate to determine an individual's response to heat stress conditions.

6.6.26 Communicate any restrictions or limitations for an individual working in temperature extremes to the appropriate Supervisor and the Human Resources (HR) department.

6.7 Cold Exposure Controls

NOTE:

Symptoms of cold exposure illness are outlined in Appendix F, *Signs and Symptoms of Cold Illnesses*

Supervisor

NOTE:

Action steps are performed sequentially unless otherwise noted.

6.7.1 Based on anticipated environmental conditions at the work location, implement the controls to protect employees from cold exposure as described on CP3-HS-2004-F01, *Hazard Identification Checklist (HIC)*, according to CP3-HS-2004, *Job Hazard Analysis*.

6.7.2 Implement engineering controls where feasible to protect employees from exposure to cold stress conditions.

6.7.3 Where engineering controls are **NOT** adequate, utilize proper protective clothing **and** implement a work or warm-up schedule according to Appendix G, *ACGIH TLV for Chemical and Physical Agents* ,Table 2 of the "Cold Stress" Section

NOTE:

Refer to Appendix G, *ACGIH TLV for Chemical and Physical Agents*, Table 1 of the "Cold Stress" section for equivalent chill temperatures.

6.7.4 **If** prolonged work is performed in an environment at an equivalent chill temperature at or below 39˚F (4˚C) **then** implement provisions for additional total body protection (such as, wind break garment, water impermeable clothing, auxiliary heated gloves or shoe inserts, etc.).

6.7.5 Consult with S&H/IH Personnel, as necessary.

Employee

NOTES:

Cold stress controls are based upon the assumption that employees are acclimated and physically fit. Employees susceptible to cold injury may require the use of extra-insulating clothing and/or a reduction in the duration of the work assignment. Precautionary actions to be taken will depend on the physical condition of the employee and should be determined in coordination with S&H/IH and the OMP.

If only light work is involved, the outer layer of clothing may be of a type that is impermeable to water. Use of water-repellent outer layer, which is changed as it becomes wet, may be more appropriate for moderate and heavy workloads.

6.7.6 Protect outer garments from becoming wet on the job.

NOTE:

Outer layers of clothing should be easily removable to afford adaptability to varying degrees of body heat production during different levels of work. External layers should be capable of being temporarily vented at waist, neck, and wrist without removal to reduce perspiration wetting.

6.7.7 Change out PPE that becomes wet, as needed, so that protection from cold is **NOT** diminished by wetting.

Supervisor

6.7.8 **If** employees are exposed to equivalent wind chill temperatures of 11˚F (-12˚C) or below, **then** follow Steps **6.7.9** through **6.7.13**.

6.7.9 Keep employees under constant protective observation (Buddy System or direct supervision).

6.7.10 Maintain a work rate to avoid heavy sweating that will result in wet clothing.

6.7.11 **If** heavy work must be done, **then** allow rest periods and opportunity for changing into dry clothing.

6.7.12 Allow employees an acclimation period before working full time in cold conditions during their first days of assignment, until they become adjusted to the working conditions and required protective clothing.

6.7.13 Where feasible, schedule work activities in such a way that sitting still or standing still for long periods is minimized.

6.8 Medical Evaluation

NOTE:

Various physiological factors such as, but **NOT** limited to, age, weight, heart conditions, high blood pressure, over-the-counter and prescription medications, past medical history, or past heat or cold injuries can affect an individual's ability to tolerate extreme heat or cold conditions.

MSP

6.8.1 Perform medical evaluations in accordance with CP3-HS-4002, *Implementation of the Occupational Medical Program*.

6.8.2 **If** an employee has an increased risk of experiencing a heat or cold related illness, **then** evaluate an individual's medical suitability to work in a temperature extremes environment by performing a medical evaluation.

6.8.3 Communicate any restrictions or limitations for an individual working in temperature extremes to the appropriate Supervisor and the HR department.

7.0 RECORDS

7.1 Records Generated

The following records may be generated by this procedure:

- CP3-HS-2000-F01, *Physiological Heart Rate Monitoring Log*
- CP3-HS-2000-F02, *WBGT Direct Reading Log*
- CP3-HS-2000-F03, *Acclimatization Schedule Log*
- CP3-HS-2000-F04, *Physiological Temperature Monitoring Log*

Forms are to be completed in accordance with CP3-OP-0024, *Forms Control*.

7.2 Records Disposition

The records are to be maintained in accordance with CP3-RD-0010, *Records Management Process*.

Appendix A – Acronyms/Definitions

ACRONYMS

ACGIH - American Conference of Governmental Industrial Hygienists

D&R – Deactivation and Remediation

HR - Human Resource

IH - Industrial Hygiene

MSP - Medical Service Provider

PGDP – Paducah Gaseous Diffusion Plant

PPE - Personal Protective Equipment

PSS - Plant Shift Superintendent

S&H - Safety & Health

TLV - Threshold Limit Values

TWA - Time-weighted average

WBGT - Wet bulb globe temperature

DEFINITIONS

Buddy System - The buddy system is the practice of organizing employees into work groups so that each employee is in view of, or in contact with, at least one other employee in the group in order to watch for signs or symptoms of heat or cold stress in their coworkers.

Cold Stress - A condition that arises from exposure to cold temperatures and wind. The physical disorders that can arise from cold stress include frostbite and hypothermia.

Effective Wet Bulb Globe Temperature - An index 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. The effective WBGT is the environmental WBGT plus the clothing adjustment factor for the PPE being worn.

Fully Encapsulated PPE - For the purposes of heat stress, a vapor impermeable suit worn with associated PPE that covers the full body.

Heart Rate – Number of measured heart beats per minute (bpm). For this procedure, the term heart rate is interchangeable with the term pulse rate.

Heat Stress - A 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 stress 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.

Appendix A – Acronyms/Definitions (Continued)

Hot Environment - A working condition that may expose employees to WBGTs above the ACGIH TLVs. Working conditions are determined by an evaluation of environmental factors (air temperature, radiant heat, air movement, and humidity), work effort and duration, and personal protective clothing and equipment.

Hypothermia - A condition that results from extreme exposures to the factors of cold stress, coupled with dehydration and/or exhaustion. A person experiencing hypothermia will usually show some or all of the following symptoms: chills, euphoria, pain in the extremities, slow and weak pulse, body temperature of less than 95° F (35° C), fatigue, drowsiness, and unconsciousness.

Modesty Clothing - Appropriately discrete body coverage for the workplace equivalent to other personal undergarments worn under coveralls or protective clothing (such as, shorts and T-shirt or long underwear)

Physiological Monitoring - Means of measuring an individual's response to working in a hot environment as a method of preventing overexposure. For the purposes of this procedure, physiological monitoring consists of measurement of heart rate and/or body temperature as a method of controlling heat related illnesses.

Wet Bulb Globe Temperature (WBGT) Index - A measurement that approximates “effective temperature” and takes into account virtually all the commonly accepted mechanisms of heat transfer (such as, radiant, evaporative, conductive, etc.). The WBGT is computed according to the following algebraic sums:

- WBGT Outdoors = 0.7 [natural wet bulb] + 0.2 [globe temperature] + 0.1 [dry bulb temperature]
- WBGT Indoors = 0.7 [natural wet bulb] + 0.3 [globe temperature]

Appendix B – WORK-REST REGIMENS FOR HEAT STRESS

The tables in this attachment identify acceptable exposure limits to heat stress while wearing various levels of protective clothing/PPE. Each table represents a different level of physical exertion required to perform an activity. Activities must be evaluated by using the following guide to determine the appropriate table to be used.

Table 1: Clothing-Adjustment Factors for Some Clothing Ensembles*

Clothing Type	Adjustment to WBGT (˚F/˚C)
Work clothes (long sleeve shirt and pants)	0/0
Cloth (woven material) coveralls	0/0
Double-layer woven clothing	5.4/3.0
SMS polypropylene coveralls (for example Quantum	0.9/0.5
Polyolefin coveralls (for example Tyvek)	1.8/1.0
Limited-use vapor-barrier coveralls (for example Saranex)	19.8/11.0

*These values must not be used for completely encapsulating suits, often called Level A. Clothing Adjustment Factors cannot be added for multiple layers. The coveralls assume that only modesty clothing is worn underneath, not a second layer of clothing. Contact S&H/IH personnel for assistance in evaluating clothing-adjustment factors for clothing ensembles not listed above.

Table 2: Screening Criteria for Heat Stress TLV (WBGT Values in ˚F/˚C)

Work Allocation	Light	Moderate	Heavy	Very Heavy
75% to 100%	87.8/31.0	82.4/28.0	--	--
50% to 75%	87.8/31.0	84.2/29.0	81.5/27.5	--
25% to 50%	89.6/32.0	86.0/30.0	84.2/29.0	82.4/28.0
0% to 25%	90.5/32.5	88.7/31.5	86.9/30.5	86.0/30.0

Table 3: Screening Criteria for Heat Stress Action Limit (WBGT Values in ˚F/˚C)*

Work Allocation	Light	Moderate	Heavy	Very Heavy
75% to 100%	82.4/28.0	77.0/25.0	--	--
50% to 75%	83.3/28.5	78.8/26.0	75.2/24.0	--
25% to 50%	85.1/29.5	80.6/27.0	77.9/25.5	76.1/24.5
0% to 25%	86.0/30.0	84.2/29.0	82.4/28.0	80.6/27.0

NOTE: WBGT levels above the Heat Stress Action Limit require that a heat stress management program be initiated and employees should be covered by general controls as detailed in the ACGIH TLV Booklet

Appendix B – WORK-REST REGIMENS FOR HEAT STRESS (Continued)

Light Work: Sitting with light manual work with hands or hands and arms, and driving. Standing with some light arm work and occasional walking.

Moderate Work: Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling; Normal walking.

Heavy Work: Intense arm and trunk work, carrying, shoveling, manual sawing; pushing and pulling heavy loads; and walking at a fast pace.

Very Heavy Work: Very intense activity at a fast to maximum pace.

- If work and rest environments are different, hourly time weighted average (TWA) WBGT should be calculated and used. TWAs for work rates should also be used when the work demands vary within the hour, but note that the metabolic rate for rest is already factored into the screening limit.
- Values in the table are applied by reference to the "Work-Rest Regimen" section of the Documentation and assume 8-hour workdays in a 5-day workweek with conventional breaks.

The heat stress limits listed in the tables on the following page are measured in degree Fahrenheit (^{o}F) by using a WBGT. The limits provided must be reduced by 4.5 ^{o}F for employees not acclimated to the heat. Allow employees to become acclimatized to the heat by slowly increasing their exposure time over a period of time (for example, five days).

The heat stress limits are established with the assumption that breaks are taken at the same temperature and condition in which the work is being performed. An average WBGT may be calculated using the following formula when breaks are taken in a cooler area:

Avg. Temp (WBGT) = Temp(1) x t(1) + Temp(2) x t(2) + Temp(n) x t(n) over t(1) + t(2) + + 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.

In addition, a "break" is defined as 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.

Consult the S&H/IH Personnel for assistance in evaluating and monitoring work activities or to adapt the charts to apply to different protective clothing/respirator ensembles.

Appendix B – WORK-REST REGIMENS FOR HEAT STRESS (Continued)

Table 4: Heat Stress Limits for *Light Work (Acclimated Employees)*

	(1)	(2)	(3)	(4)
Work/Rest	**WBGT °F**	**WBGT °F**	**WBGT °F**	**WBGT °F**
CONT.	87.8	86.0	82.4	68.0
75/25	88.7	86.9	83.3	68.9
50/50	89.6	87.8	84.2	69.8
25/75	90.5	88.7	85.1	70.7

Table 5: Heat Stress Limits for *Moderate Work (Acclimated Employees)*

	(1)	(2)	(3)	(4)
Work/Rest	**WBGT °F**	**WBGT °F**	**WBGT °F**	**WBGT °F**
CONT.	82.4	80.6	77.0	62.6
75/25	84.2	82.4	78.8	64.4
50/50	86.0	84.2	80.6	66.2
25/75	88.7	86.9	83.3	68.9

Table 6: Heat Stress Limits for *Heavy Work (Acclimated Employees)*

	(1)	(2)	(3)	(4)
Work/Rest	**WBGT °F**	**WBGT °F**	**WBGT °F**	**WBGT °F**
CONT.	N/A	N/A	N/A	N/A
75/25	81.5	79.7	76.1	61.7
50/50	84.2	82.4	78.8	64.4
25/75	86.9	85.1	81.5	67.1

(1) No PPE
(2) One pair coveralls (Cotton Anti-Cs, SMS polypropylene, or polyolefin), modesty clothing, gloves, hood, and shoe covers
(3) Two pair coveralls (Cotton Anti-Cs or SMS polypropylene), modesty clothing, gloves, hood, shoe covers
(4) Two pair coveralls (Polyolefin), modesty clothing, gloves, hood, shoe covers OR vapor barrier impermeable clothing

NOTE: At the discretion of the S&H/IH Personnel, physiological monitoring may be used in conjunction with the work-rest regimen provided above. Refer to Appendix C for physiological monitoring guidelines.

Appendix B – WORK-REST REGIMENS FOR HEAT STRESS (Continued)

Table 7: Heat Stress Limits for *Light Work (Un-acclimated Employees)*

	(1)	(2)	(3)	(4)
Work/Rest	**WBGT ^{o}F**	**WBGT ^{o}F**	**WBGT ^{o}F**	**WBGT ^{o}F**
CONT.	83.3	81.5	77.9	63.5
75/25	84.2	82.4	78.8	64.4
50/50	85.1	83.3	79.7	65.3
25/75	86.0	84.2	80.6	66.2

Table 8: Heat Stress Limits for *Moderate Work (Un-acclimated Employees)*

	(1)	(2)	(3)	(4)
Work/Rest	**WBGT ^{o}F**	**WBGT ^{o}F**	**WBGT ^{o}F**	**WBGT ^{o}F**
CONT.	77.9	76.1	72.5	58.1
75/25	79.7	77.9	74.3	59.9
50/50	81.5	79.7	76.1	61.7
25/75	84.2	82.4	78.8	64.4

Table 9: Heat Stress Limits for *Heavy Work (Un-acclimated Employees)*

	(1)	(2)	(3)	(4)
Work/Rest	**WBGT ^{o}F**	**WBGT ^{o}F**	**WBGT ^{o}F**	**WBGT ^{o}F**
CONT.	N/A	N/A	N/A	N/A
75/25	77.0	75.2	71.6	57.2
50/50	79.7	77.9	74.3	59.9
25/75	82.4	80.6	77.0	62.6

(1) No PPE
(2) One pair coveralls (Cotton Anti-Cs, SMS polypropylene, or polyolefin), modesty clothing, gloves, hood, and shoe covers
(3) Two pair coveralls (Cotton Anti-Cs or SMS polypropylene), modesty clothing, gloves, hood, shoe covers
(4) Two pair coveralls (Polyolefin), modesty clothing, gloves, hood, shoe covers OR vapor barrier impermeable clothing

NOTE: At the discretion of the S&H/IH Personnel, physiological monitoring may be used in conjunction with the work-rest regimen provided above. Refer to Appendix C for physiological monitoring guidelines.

Note: Tables 7, 8, 9 are intended for un-acclimated workers that do not routinely work in hot environments (for example support groups, vendors, visitors) and due to their exposure frequency will not become acclimatized.

Appendix C – PHYSIOLOGICAL MONITORING FOR HEAT STRESS

This attachment identifies those physiological parameters available for evaluation of heat stress. Physiological monitoring measures an individual's response to heat as a method of preventing heat stress. The goal is to maintain temperatures less than or equal to 99.4 ^{o} F. 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 (heart rate and/or body temperature) is performed on individuals when any of the conditions in Step **5.5** are met. This will allow personnel to adjust the work-rest regimen according to their individual tolerance for heat. This may result in a work period that exceeds those allowed in Appendix B. Periods without water/rest may not exceed 2 hours. Rest periods must be at least as long as the required rest period determined by the WBGT and must be long enough to allow for recovery and adequate hydration. Employees will not be allowed to return to work until temperature and/or heart rate are below acceptable limits.

It may also result in a more restrictive or less restrictive work period for individuals with a low tolerance to heat stress. Individuals displaying a low tolerance to heat stress may need to receive further medical evaluation for fitness to work in high temperature conditions.

Physiological monitoring is conducted using one of the following methods:

1. Heart Rate Monitoring

   a. Heart Rate Monitoring (during work period)

      When work is performed in a hot environment and physiological monitoring is being used, discontinue any environmentally induced or activity induced heat stress for an individual when the sustained heart rate is greater than 180 beats per minute (bpm) – age for two or more minutes. Example: A 40 year old employee's maximum working heart rate is 180 – 40 or 140 bpm. This limit only applies to healthy adults taking no medications. A real-time personal heart rate monitoring device is required to be used to monitor the heart rate during the work period.

      For employees taking prescribed medications that may affect heart rate, specific recommendations for physiological monitoring will be provided by the Medical Services Provider.

   b. Heart Rate Monitoring (at rest)

      One of the following methods may be used to determine heart rate prior to starting work and after going on break:

      1) Determine the pulse using an approved digital pulse monitor **or** count the radial pulse during a 30 second period just prior to starting work and as early as possible after going on break (1-2 minutes) **and** multiply by 2 to get the number of bpm.

      2) Determine personal heart rate using real time heart rate monitor just prior to starting work and as early as possible after going on break (1-2 minutes).

         - **If** pre-work heart rate measurements exceed 110 beats per minute (bpm), **then do not** begin work.
         - **If** the heart rate exceeds 110 bpm at the beginning of the rest period, **then** shorten the next work cycle by one third **and** keep the rest period the same. Continue this process until the heart rate is less than 110 bpm at 1-2 minutes into the rest period.

Appendix C – PHYSIOLOGICAL MONITORING FOR HEAT STRESS (Continued)

The individual's work cycle may only be adjusted three times. If the individual's heart rate is above 110 bpm after the 3rd adjusted work cycle immediately notify the MSP **and** accompany the worker to the onsite medical facility.

2. Body Temperature Monitoring (work-rest regimen)

Body temperature monitoring may be performed at any time during the work period or as early as possible after going on break (1-2 minutes). Body temperature may be taken orally or by aural/tympanic (ear) means. Oral temperatures must be taken prior to drinking replacement fluids.

- **If** the body temperature exceeds 99.4° F, **then do NOT** permit an employee to enter a work area**.**
- **If** the body temperature exceeds 99.4° F at the beginning of the next rest period, **then** shorten the next work cycle by one third **AND** keep the rest period the same. Continue this process until the body temperature is less than 99.4 ° F at 1-2 minutes into the rest period.

The individual's work cycle may only be adjusted three times. **If** the individual's body temperature is above 99.4 ° F after the 3rd adjusted work cycle immediately, **then** notify the MSP **and** accompany the worker to the onsite medical facility.

Appendix D – GUIDELINES FOR IMPLEMENTING TEMPERATURE EXTREME WORK REQUIREMENTS

Initial hazard screening for temperature extremes will need to be incorporated into the work control documents, operating procedures/instructions, permits, activity hazard analyses, pre-job briefings, safety plans, or other media.

Project Supervisor shall contact S&H/IH Personnel and/or radiological protection, fire protection, criticality safety, environmental, and other appropriate organizations for assistance and direction in completing activity hazard analyses, permits, safety plans, procedures, and other command media where there is a potential for heat/cold stress.

As deemed necessary, Project Supervisor shall contact their S&H/IH Personnel for evaluations, monitoring, and recommendations of heat/cold stress controls including work-rest regimens or physiological monitoring (heart rate and/or body temperature), as well as for engineering, administrative, and PPE control guidance.

Project Supervisor is responsible for implementing recommended controls in the work control documents (i.e. work instructions, activity hazard analyses, permits, etc.), and obtaining PPE. Employees are responsible for following recommendations and informing supervisors of any signs and symptoms of heat/cold stress.

Appendix E – SIGNS AND SYMPTOMS OF HEAT ILLNESSES

Heat Cramps

- Heat cramps are often caused by a combination of heat and exertion that cause the body to sweat and lose water and salt.
- 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.

Heat Exhaustion

- Heat exhaustion occurs when the body loses too much water and/or salt and becomes fatigued.
- 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.

Heat Stroke

- Heat stroke is 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 and until help arrives, cool the person immediately and rapidly. Do **NOT** attempt to give an unconscious victim any fluids.

If questions arise regarding heat stress or heat-induced illnesses, **then** the individual should contact their supervisor, S&H/IH Personnel, or OMP.

Appendix F – SIGNS AND SYMPTOMS OF COLD ILLNESSES

Several factors increase the harmful effects of cold including, being very young or old, wet clothing, having wounds or fractures, smoking, drinking alcoholic beverages, fatigue, emotional stress and certain diseases and medications. The two most prominent adverse effects from exposure to cold temperatures are frostbite and hypothermia.

A person qualified in first aid or a professional medical provider should administer treatment for cold related injuries.

Frostbite

- Frostbite is the most common injury caused by exposure to cold temperatures. It occurs when cells of the body freeze restricting blood flow and causing tissue damage. The first sign of frostbite is slightly flushed skin which then changes to white or grayish yellow and finally grayish blue. Pain is sometimes initially felt but is often followed by a cold numb feeling.

Hypothermia

- Hypothermia is the most severe form of cold stress and results from a drop in the body temperature.

  The initial signs include:

  1. Shivering
  2. Numbness
  3. Confusion
  4. Weakness
  5. Impaired judgment and vision
  6. Drowsiness

- Hypothermia victims typically progress through five stages of the condition including:

  1. Shivering
  2. Apathy
  3. Loss of consciousness
  4. Decreasing pulse and breathing rate
  5. Death

Appendix G – ACGIH TLV for Chemical and Physical Agents

Table 1

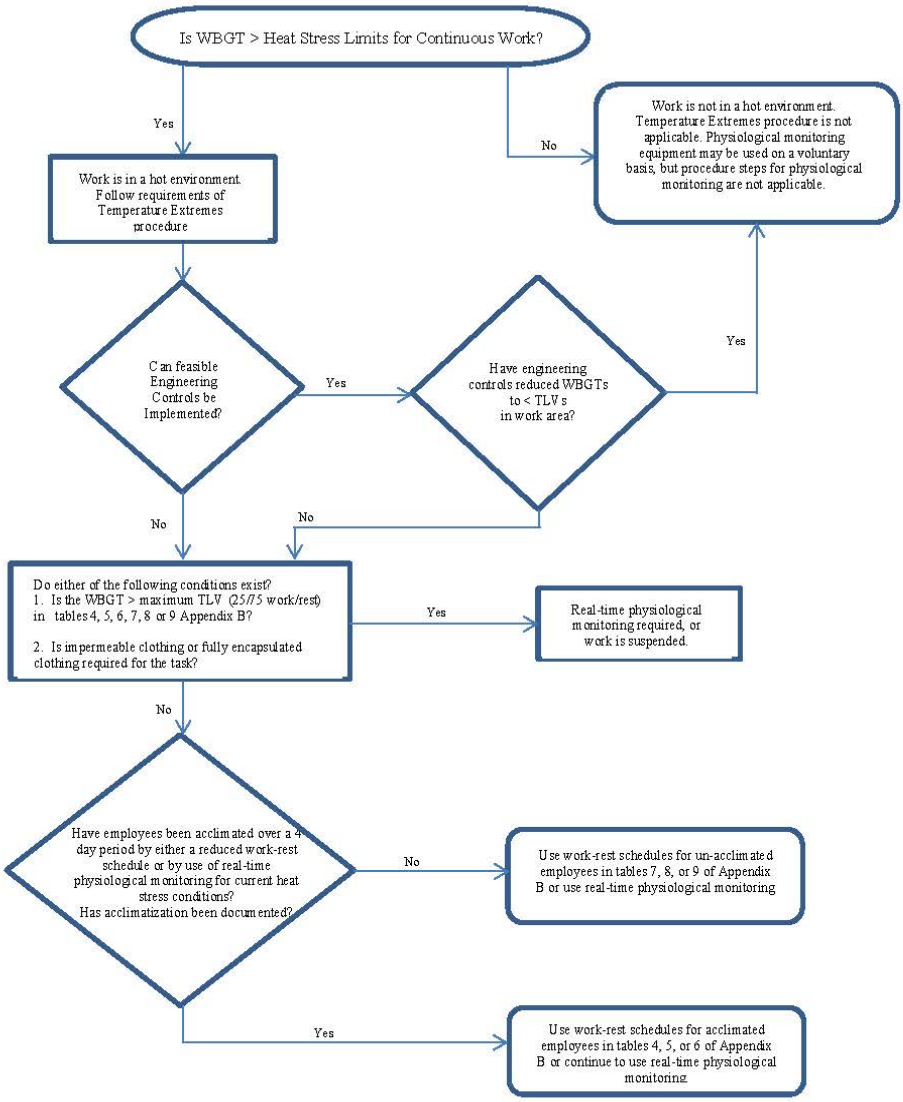
Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57	−68
10	40	28	16	4	−9	−24	−33	−46	−58	−70	−83	−95
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99	−112
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110	−121
25	30	16	0	−15	−29	−44	−59	−74	−88	−104	−118	−133
30	28	13	−2	−18	−33	−48	−63	−79	−94	−109	−125	−140
35	27	11	−4	−20	−35	−51	−67	−82	−98	−113	−129	−145
40	26	10	−6	−21	−37	−53	−69	−85	−100	−116	−132	−148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Equivalent chilll temperature requiring dry clothing to maintain core body tempearture above 36°C (96.8°F) per cold stress TLV

Table 2.

THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*

Air Temperature Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
° C (approx)	° F (approx)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	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° to below	-45° & below	Non-emergency work should cease									

Appendix H – HEAT STRESS CONTROL OPTIONS DECISION-MAKING DIAGRAM