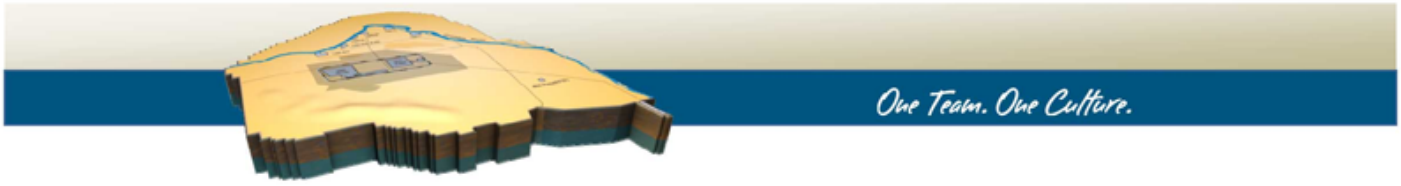

Administrative Procedure

PRC-PRO-SH-121

Heat Stress Control

Revision 1, Change 2

Published: 04/06/2015
Effective: 04/06/2015

Program: Occupational Safety and Industrial Hygiene
Topic: Occupational Safety and Industrial Health

Technical Authority: Roblee, Richard
Functional Manager: Roueche, Kimberly

Use Type: Administrative

JHA: Administrative
Periodic Review Due Date: 04/06/2019
Rev. 1, Chg. 2
USQ Screen Number:

- 100 K Facility : Excluded from USQ
  Exclusion Reason:
  Exempt from USQ Process per PRC-PRO-NS-062 Table B-1.
- Canister Storage Building/Interim Storage Area : Excluded from USQ
  Exclusion Reason:
  Exempt from USQ Process per PRC-PRO-NS-062 Table B-1.
- Central Plateau Surveillance and Maintenance : Excluded from USQ
  Exclusion Reason:
  Exempt from USQ Process per PRC-PRO-NS-062 Table B-1.
- Less Than HazCat 3 : Excluded from USQ
  Exclusion Reason:
  Exempt from USQ Process per PRC-PRO-NS-062 Table B-1.
- Plutonium Finishing Plant : Excluded from USQ
  Exclusion Reason:
  Exempt from USQ Process per PRC-PRO-NS-062 Table B-1.
- Solid Waste Operations Complex : Excluded from USQ
  Exclusion Reason:
  Exempt from USQ Process per PRC-PRO-NS-062 Table B-1.
- Transportation : Excluded from USQ
  Exclusion Reason:
  Exempt from USQ Process per PRC-PRO-NS-062 Table B-1.
- Waste Encapsulation Storage Facility : Excluded from USQ
  Exclusion Reason:
  Exempt from USQ Process per PRC-PRO-NS-062 Table B-1.

CHANGE SUMMARY

Description of Change

Remove note refereeing to removed appendix.

Heat Stress Control

Published Date: 04/06/2015
Effective Date: 04/06/2015

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1.0 INTRODUCTION

1.1 Purpose

This procedure establishes requirements and processes for working in CH2M HILL Plateau Remediation Company (CHPRC) areas when conditions have the potential for heat stress to develop. Following these requirements will assist in compliance with 10 CFR 851, *Worker Safety & Health Program.*

1.2 Scope

This procedure applies to all CHPRC activities where potential heat stress conditions may be involved.

This procedure does not direct the Site Occupational Medical Provider (SOMP) in the treatment of Heat Strain nor does it direct the SOMP on how they clear personnel to work in hot environments.

Additionally, abnormal or emergency response activities where work planning is not practical (such as fire department and patrol) are not covered by this procedure.

1.3 Applicability

This Level 2 procedure is applicable to CHPRC Team employees and subcontractor personnel who may work in areas with a potential for heat stress.

1.4 Implementation

This procedure is effective upon publication.

2.0 RESPONSIBILITIES

All responsibilities associated with this procedure are identified in the process steps.

3.0 PROCESS

3.1 Preparation for the Heat Stress Season

Actionee	*Step*	*Action*
Line Management/ Engineering/ Maintenance/ OS&IH Professional	1.	Prior to Heat Stress Season (January – April), MAKE preparations for the upcoming heat season and anticipated work. This preparation includes: • inventorying supplies, • preventive maintenance on equipment, • planning start time adjustments, • determination of type and supplies needed for cool zones, • ordering supplies, • as appropriate, set up cool zones, • and ensuring that they are operational.

3.2 Identification and Evaluation of Heat Stress Conditions

Actionee	*Step*	*Action*
Line Management	1.	Prior to releasing work, ENSURE the work activity has been evaluated for the potential for heat stress.

NOTE: *The evaluation should take into account the level of PPE worn, the potential for solar loading (reflective surfaces/asphalt) and the Work Category (Light, Medium, Heavy and Very Heavy Work).*

2. IF solar loading potential exists,
   THEN CONTACT an Occupational Safety/Industrial Hygiene (OS/IH) professional to assist in the evaluation.

The following are conditions that can result in heat stress:

a. Predicted High Temperatures – Will the work be performed when the air temperature may contribute to heat stress (outdoor work above 85 ° F in level D PPE/indoor work above 90° F in level D PPE).
b. Humidity – levels above 60% relative humidity are unusual in this area and require additional considerations.
c. Sources of radiant heat, such as steam pipes, boilers, heated vessels, welding operations, reflection from horizontal and vertical surfaces, and stored heat from asphalt surfaces.
d. Use of protective clothing, (wearing a single pair of coveralls at temperatures above 70° F, wearing two pair of any type of coveralls or wearing an impermeable coverall/clothing at any temperature).
e. High work intensity and long duration work including extended shift work.
f. Outdoor operation with high solar loads such as construction, asbestos abatement, or hazardous waste activities.
g. Direct physical contact with hot objects.
h. Work performed in a greenhouse or other enclosures during conditions that could result in heat buildup or other environments with minimal air movement.

3. IF the task is determined to have heat stress potential,
   THEN PERFORM a job hazard analysis
   AND INCLUDE OS&IH professional in this analysis.

NOTE:
- The OS&IH Professional will review the potential heat stress conditions and the engineering and/or administrative controls that should be implemented, which may include the use of physiological evaluation (monitoring). In addition, the OS&IH professional will work with Line Management to determine worker acclimatization.
- If a significant amount of time has elapsed between the preparation of the Hazard Analysis and the work, re-evaluation of the work conditions to ensure the heat stress hazards are adequately addressed may need considered.

Actionee	*Step*	*Action*
	4.	IF the OS&IH Professional determines that heat stress controls are necessary, THEN IMPLEMENT recommended heat stress controls. These controls may include both engineering and administrative controls as well as personal protective equipment.
	5.	As needed, OBTAIN AND USE Wet bulb globe temperature (WBGT) data, the classification of the work activity level (workload) and clothing adjustment factors (CAFs). This information can be used in conjunction with Appendix A (with OS&IH Professional involvement) to establish work/rest regimens.
	6.	RECORD the completion of the evaluation AND use of work/rest regimens in the work record or facility logbook.
NOTE:		*The WBGT data can be obtained by taking a WBGT reading at the worksite or using the WBGT reading from the Hanford Weather Station when appropriate (It is not appropriate to use the Hanford Weather Station WBGT if work is being conducted inside or around reflective surfaces or in areas with little to no air movement). For additional information about the Hanford Weather Station you can consult Appendix E or ask your OS/IH professional.*
OS&IH Professional	7.	As requested, ASSIST line management in evaluating the risk for heat stress on a task/job via the hazard analysis process.
	8.	CONDUCT an exposure assessment to determine if physiological monitoring, a work/rest regimen or other engineering and/or administrative controls are needed to reduce the potential for heat stress.
	9.	ENTER WBGT readings taken into the Sitewide Industrial Hygiene Database (SWIHD).
	10.	IF physiological monitoring is to be considered THEN Consult Appendix C.
NOTE:		*The data obtained from a WBGT used for information purposes only does not have to be recorded and maintained in SWIHD. Only WBGT data used to establish work/rest regimens needs to be recorded.*
	11.	IF a work/rest regimen is used, THEN CONSULT Appendix B. The WBGT, clothing adjustment factor, workload and acclimatization/unacclimatization status should be used to determine if a work/rest regimen is appropriate and what work/rest time intervals should be established.

Actionee	Step	Action
	12.	IF work/rest regimens do not provide the proper level of control, THEN the OS&IH Professional can determine if a more detailed analysis is appropriate or if physiological monitoring is required (See Appendix C).

3.3 Applying Heat Stress Control Strategies

Actionee	Step	Action
Line Management	1.	ENSURE work performed in a hot environment is under the direction of a supervisor who knows the early signs/symptoms of heat illness and who can enforce the permissible work/rest regimen and other established controls.
	2.	IF workers are not acclimatized to the hot working environment, THEN ENSURE that the OS&IH Professional is informed so that unacclimatized temperatures are used from Table 3.
	3.	CONSULT the OS&IH Professional for guidance on worker acclimatization.
	4.	ENSURE water/fluids are accessible in the work area and provided to workers as needed.
		a. ENCOURAGE workers to consume adequate quantities of water and to drink fluids prior to entering the work area b. IF the OS&IH Professional determines that heat stress conditions exist in a radiological contamination area, THEN PROVIDE fluids in accordance with CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual.*
	5.	USE engineering controls as the primary way to reduce heat stress.
		a. IF engineering controls are not feasible or are inadequate, THEN administrative controls should be used to further reduce the exposure to heat stress.

NOTE: *When temperatures are at or in excess of 95°F, forced air ventilation should not be used unless the ventilation air is cooled.*

- *Examples of engineering controls include insulation or shielding of hot equipment and surfaces, local exhaust ventilation, shade tents, and forced ventilation of a work area.*
- *Examples of administrative controls include scheduling work for cooler parts of the day, rotating tasks among workers, and applying work/rest regimens.*

	6.	ADJUST the employee's work schedule, work load, and work/rest regimen as prescribed by the OS&IH Professional.
	7.	ESTABLISH worksite-specific heat stress surveillance (see Appendix

Actionee	Step	Action
		B) with the OS&IH Professional when indicated in subsection 3.2.
	8.	PROVIDE a cool-down area adjacent to the hot environment.
		a. ADJUST the length of the cool-down period in accordance with guidelines for applicable work/rest regimens and ACGIH's TLV.
	NOTE:	*When radiation or IH contaminants are present, decontamination may be required prior to exit of the work area and entrance into the cooling area.*
	9.	PROVIDE personal protective equipment, cooling devices, and accessory equipment, (such as insulated gloves, reflective clothing, cool ties, ice vests, vortex suits), as recommended by the OS&IH Professional and with the concurrence of RadCon.
	10.	ENSURE jobs which require the use of radiological or chemical protective clothing are planned with consideration for heat stress.
	11.	IMPLEMENT physiological evaluation (monitoring) strategies when appropriate and as recommended by the OS&IH Professional. (See Appendix C.)
OS&IH Professional	12.	ENSURE that the work record properly documents the use of engineering and administrative controls and other information as necessary regarding heat stress activities.
	13.	ASSIST line management in applying heat stress exposure guidelines to evaluate the potential for heat stress.
		a. PROVIDE assistance as requested and/or establish the work/rest regimen with respect to temperature, work load, protective clothing, and cooling devices etc.
	14.	RECOMMEND appropriate environmental monitoring and physiological evaluation (monitoring) methodologies, engineering controls, administrative controls, and personal protective equipment to prevent heat strain.
	15.	COLLECT, INTERPRET, AND DOCUMENT worksite-specific heat strain environmental monitoring and physiological evaluation (monitoring) data as appropriate. (See Appendix C.)
	16.	Based on temperature, work load category, and protective clothing requirements, DETERMINE if workers will need cooling devices while performing tasks:
		a. ENSURE RadCon is involved in the decision making process.
	17.	As requested, ASSIST line management in purchasing, issuing, and using of cooling devices or other protective equipment.

Actionee	Step	Action
		a. ENSURE RadCon is involved.
	18.	COLLECT WBGT data from the worksite AND ENTER it into the Sitewide Industrial Hygiene Database (SWIHD). a. ENTER the data into SWIHD per the requirements of PRC-PRO-SH-409, *Industrial Hygiene Monitoring, Reporting and Records Management*. b. USE Site Form A-6004-691, *WBGT Monitoring,* to collect data for future entry into SWIHD.

3.4 Employee Awareness and Training

Actionee	Step	Action
Line Management	1.	ENSURE that employees who are working in or supervising work in hot environments are trained in heat stress recognition, prevention, and control. Training should address: a. Identification of heat stress hazards and potential health effects. b. Predisposing factors and relevant signs and symptoms of heat injury and illness. c. Information on water/fluid intake. d. Heat strain control strategies such as work practices and engineering controls, proper acclimatization, and proper use of heat strain personal protective equipment. e. Potential for therapeutic drugs, over-the-counter medications, or social drugs (including alcohol) to increase the risk of heat injury or illness by reducing heat tolerance. f. Other factors that potentially impact heat stress such as lifestyle, age, gender and/or medical conditions.
	2.	CONDUCT AND DOCUMENT this training in a training course, safety meeting, pre-job briefing, or other appropriate forum.
	3.	INCLUDE worksite-specific heat strain prevention information in regular pre-job briefings.
	4.	COMMUNICATE temperature readings, environmental data, and heat stress information to affected employees.
OS&IH Professional	5.	As requested, PARTICIPATE in pre-job briefings or other processes communicating the hazards associated with heat stress conditions at the work site and the control methods to be used.
	6.	As appropriate, CONTRIBUTE to training of management and employees in heat stress related topics.
Employees	7.	PARTICIPATE in heat strain prevention activities, including training and pre-job briefings and work planning.

Actionee	Step	Action
	8.	BE AWARE of mechanisms to avoid heat strain such as adequate water consumption.
	9.	RECOGNIZE the signs and symptoms of heat strain.
	10.	IF signs and symptoms of heat strain develop, THEN INFORM supervisors and take appropriate action, such as immediately exiting the work area.

3.4 Medical Aspects of Heat Strain Control

Actionee	Step	Action
Line Management	1.	RECOGNIZE work conditions that may require employees to be medically evaluated.
	2.	ENSURE first aid and emergency procedures for response to heat strain related illnesses are established and communicated to employees.
	3.	SEND employees to the SOMP for assessment of an employee's ability to work in hot environments and to wear prescribed personal protective equipment.
OS&IH Professional	4.	INVESTIGATE heat strain cases as requested by the SHS&Q Management AND PROVIDE results to line management.

4.0 FORMS

A-6004-691, *WBGT Monitoring*

5.0 RECORD IDENTIFICATION

All records are required to be managed in accordance with PRC-PRO-IRM-10588, *Records Management Processes*. OCRWM records are also managed in accordance with PRC-PRO-QA-19579, *OCRWM Records Management*.

Records Capture Table

Name of Record	Submittal Responsibility	Retention Responsibility	OCRWM Retention Schedule (If OCRWM Related)

6.0 SOURCES

6.1 Requirements

10 CFR 851, *Worker Safety and Health Program*

6.2 References

CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*
PRC-PRO-WKM-079, *Job Hazard Analysis*
PRC-PRO-SH-409, *Industrial Hygiene Monitoring, Reporting and Records Management*

Appendix A - Glossary

TERM	DEFINITION
Acclimatization	The gradual adaptation of an individual to a hot environment. The degree to which a worker is acclimatized to hot environments directly affects how well the body tolerates heat load. Age, gender, and physical fitness affect the period of time for acclimatization to occur; acclimatization can usually be achieved after five to seven days of graduated exposure at the hot job.
Apparent temperature	A temperature and relative humidity index provided by Hanford Site weather station that relates to potential for various heat syndromes; based on National Weather Association apparent temperature chart.
Cool down area	A rest area normally located as close to the worksite as possible, where workers can periodically enter to cool down after working in hot environments. Areas should be shaded and maintained cooler than the work area.
Core body temperature	Temperature of the internal core body. 100.4 F° (unacclimatized) and 101.3 F° (acclimatized) is the limit for daily prolonged work under heat stress conditions. Measured in the field either by tympanic, skin, or oral temperature readings.
Heat exhaustion	A heat disorder recognized by profuse sweating, weakness, rapid pulse, dizziness, nausea, and headache. The skin is cool and sometimes pale and clammy with sweat. Body temperature is normal or subnormal. Nausea, vomiting, and unconsciousness may occur.
Heat Strain	Physiological response to heat stress recognized by: • Increased core body temperature. • Increased heart rate. • Sweating. If these responses are not controlled, these symptoms may progress and result in heat strain disorders and higher accident rates.
Heat Stress	The total heat load on the body that results from exposure to external sources and from internal metabolic heat production due to physical work. It occurs when the body produces or gains more heat than it is capable of giving off or losing. Contributing environmental factors affecting the potential for heat strain include air temperature, humidity, radiant heat exchange, and air movement.
Heat Stroke	A life-threatening heat-disorder characterized by diminished or absent sweating. The skin is hot, dry, and flushed. Heat Stroke results in increased core body temperature, which, if uncontrolled, may lead to delirium, convulsions, coma, and even death. Medical care is urgently needed.

Appendix A - (Cont.)

TERM	DEFINITION
Hot Environment	A work area where one or more of the following factors may exist, creating the potential for heat strain: high temperature/humidity, sources of significant radiant heat, or use of protective clothing which impedes seat evaporation.
Rest	A cessation of work which is causing the heat stress situation and relocation to a shaded environment to allow for cool-down between work periods. Personal protective equipment (PPE) should be removed (if possible) and the employee should be seated (as possible) during rest periods. Rest does not mean a total cessation of work (i.e. paperwork). Only the cessation of the activity which created the heat stress situation
Wet bulb globe temperature	Environmental temperature index used to assess the potential for heat strain. WBGT values may be measured with integrated equipment or calculated using readings from a globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer.
Work/rest regimen	The proportion of time that an individual spends working and resting during an hour (1-hour duration), and is established based on the WBGT index, work activity level (workloads) exertion level, personal protective equipment worn, and acclimatization status.

Appendix B - Establishing Work/Rest Regimens

Appendix B provides guidance for the determination of work/rest regimens if they are to be used as an administrative control to reduce the potential to heat stress.

Determine if Work/Rest regimens can be established.

The application of work/rest regimens varies depending on the WBGT indices, clothing, work activity level (workload), and the worker's level of acclimatization.

The worksheet below can be used to help establish the work/rest regimens. Table 1, Table 2 and Table 3 from this Appendix, are used in this evaluation.

Table 3 provides ACGIH heat stress TLVs (work/rest regimens) for several work activity levels. This table assumes that employees do not wear protective equipment to reduce heat exposure (e.g., ice vests, vortex suits, etc.).

When personal protective equipment is used to reduce heat exposure, an OS&IH Professional should be contacted for guidance on how to evaluate this situation.

Heat Stress Work Sheet

1. What is the WBGT reading (F°) in the work area?	
2. What is the WBGT clothing adjustment factor (F°)?	
3. Add Values from #1 and #2.	
4. Identify the expected work demand category.	Light □ Moderate □ Heavy □ Very Heavy □
5. Acclimatized □	Unacclimatized □
	Work/Rest Determination
6. Compare WBGT value from line 3, the work demand category from Line 4 and the acclimatization status from Line 5 to Table 3 to obtain work/rest times.	Work Time
	Rest Time
NOTE: *If WBGT value is greater than those given in Table 3, then the OS&IH Professional must do a detailed analysis and/or physiological monitoring must be performed.*	

Appendix B - (Cont.)

Table 1 – WBGT Clothing Adjustment Factor (CAF) in F°

Clothing Ensemble – Single Pair	CAF
Work Clothes – Level D (long sleeve shirt and long pants)	0.0
Cloth Coveralls – (Woven Material – Cotton) – Single Pair	0.0
Polyvinyl Acetate (Orex Ultra/Deluxe) – Single Pair	0.9
Polyolefin/Polyethylene (Tyvek) – Single Pair	1.8
Polyolefin (ProTech 2000) – Single Pair	1.8
Polypropylene (Quantumwear/Q-Gard) – Single Pair	1.8
Polyvinyl Chloride Acid Suit – Single Pair	9.0
Polyethylene coated Tyvek (Tychem QC) – Single Pair	18.0
Clothing Ensemble – Two Pair	**CAF**
Clothing Ensemble – Multiple Pair	3.6
Cloth Coveralls (Woven Material – Cotton) – Two Pair	3.6
Polyvinyl Acetate (Orex Ultra/Deluxe) – Two Pair	4.5
Polyolefin (ProTech 2000) – One Pair with Cloth Coveralls	5.4
Polyolefin (ProTech 2000) – Two Pair	5.4
Polypropylene (Quantumwear/Q-Gard) – Two Pair	5.4

NOTE: *Contact the Heat Stress TA/SME if CAFs are needed for other protective clothing. The TA/SME will assist in the evaluation of protective clothing and clothing combinations.*

Appendix B - (Cont.)

Table 2 – Work Category Guidelines (Workloads)

Category	Example Activities
Light	Sitting w/moderate arm and leg movement Standing w/light work at machine/bench using mostly arms Using table saw Standing w/light to moderate work at machine/bench and some walking about Data Logging
Moderate	Performing rounds on level ground with moderate pushing and pulling Walking about w/moderate lifting or pushing Walking on level ground (at 5 mph) while carrying 6.5 lbs. weight Moving waste drums using mechanical means Using a power tool (drill, skilsaw) RO/RO Container opening/closing
Heavy	Carpenter sawing by hand Shoveling dry sand/soil Moving waste or laundry bags Intermittent heavy lifting with pushing and pulling Heavy assembly work on a non-continuous basis Carrying materials up stairs
Very Heavy	Shoveling wet sand/soil

Appendix B - (Cont.)

Table 3 – Screening Criteria for Heat Stress Exposure (WBGT Values)

	Acclimatized				Unacclimatized			
Work Demands	**Light**	**Moderate**	**Heavy**	**Very Heavy**	**Light**	**Moderate**	**Heavy**	**Very Heavy**
100% Work	85.1 F°	81.5 F°	78.8 F°	N/A	81.5 F°	77.0 F°	72.5 F°	N/A
75% Work 25% Rest	86.9 F°	83.3 F°	81.5 F°	N/A	84.2 F°	79.7 F°	76.1 F°	N/A
50% Work 50% Rest	88.7 F°	85.1 F°	83.3 F°	81.5 F°	86.0 F°	82.4 F°	79.7 F°	77.0F°
25% Work 75% Rest	90.5 F°	87.8 F°	86.0F°	85.1 F°	87.8 F°	84.2 F°	82.4 F°	79.7F°

NOTE: *The temperature shown is the maximum temperature in that work rest cycle. If the WBGT reading is above that number the next work rest cycle is started. Measurements are only taken once an hour. If the WBGT reading is above the posted 25%/75% work/rest reading OS&IH Professionals must be contacted if work is to continue. The OS&IH Professional will evaluate the work with the supervisor to determine the strategy to continue working. Minimum physiological controls may be considered as the method to ensure safe working conditions.*

Appendix C - Physiological Evaluation (Monitoring)

Physiological evaluation (monitoring) can be used to determine the potential heat stress risk to a worker. In certain applications when impermeable clothing is used or the potential for heat stress cannot be controlled by engineering and/or administrative controls, the use of physiological evaluation is imperative. In these situations, engineering and administrative controls shall be used to reduce the potential for heat stress (if possible) and then physiological evaluation (monitoring) will be used as an additional method to monitor heat stress.

This appendix provides guidance on the various methods of physiological evaluation (monitoring) for use by OS&IH Professionals. The most widely recognized measures for evaluating excessive levels of heat strain are: sustained heart rate, body core temperature, recovery heart rate and physical symptoms of excessive heat strain.

Sustained Heart Rate

"Sustained (several minutes) heart rate (SHR) is in excess of 180 beats per minute (bpm) minus the individual's age in years (e.g. 180 – age), for individuals with assessed normal cardiac performance."

If a Project determines that sustained heart rate is going to be used to monitor for heat strain, notify the TA and review the proposed process with the TA.

1. Prior to starting work where SHR will be used to monitor for heat strain, establish personal monitoring process to be used and the means for identifying the supervisor/employee when the SHR is above 180 bpm minus the employee's age for several minutes and what actions will be taken.
2. Select the equipment (i.e. Nonin Onyx Finger Pulse Rate Monitor, Polar Chest Pulse Rate Monitor) that will be used to monitor heart rate.
3. Establish if the heart rate will be monitored continuously or intermittently (initial intervals should be no longer than 30 minutes until data demonstrates longer intervals are appropriate).
4. Review the personal monitoring process to be used in the pre-job brief to ensure supervisors/employees working this task/job are informed of the process.

Core Body Temperature

"Body core temperature is greater than 101.3°F for medically selected and acclimatized personnel, or greater than 100.4°F in unselected, unacclimatized workers."

If a Project determines that core body temperature is going to be used to monitor for heat strain, notify the TA and review the proposed process with the TA.

Appendix C - (Cont.)

Recovery Heart Rate

"Recovery heat rate at one minute after a peak work effort is greater than 110 bpm."

If a Project determines that recovery heart rate is going to be used to monitor for heat strain, notify the TA and review the proposed process with the TA.

1. Prior to starting work where recovery heart rate will be used to monitor for heat strain, establish personal monitoring process to be used and the means for identifying the supervisor/employee when the recovery heart rate is above 110 bpm and what actions will be taken.
2. Select the equipment (i.e. Nonin Onyx Finger Pulse Rate Monitor, Polar Chest Pulse Rate Monitor) that will be used to monitor heart rate.
3. Establish the interval for monitoring recovery heart rate (initial intervals should be no longer than 30 minutes until data demonstrates longer intervals are appropriate).
4. Review the personal monitoring process to be used in the pre-job brief or in another format that ensures supervisors/employees working this task/job are informed of the process.

NOTE: *The "Recovery Heart Rate" may be used in conjunction with the "Sustained Heart Rate" as a means to monitor for heat strain.*

Physical Symptoms of Excessive Heat Strain

"There are symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness."

If a Project determines that observation of heat strain symptoms is going to be used to monitor for heat strain, notify the TA, review the proposed process with the TA and obtain the TA approval to use the process.

Other methods of personal monitoring for heat strain (i.e. weight loss) may be available. If a Project decides to use one of these other methods, notify the TA, review the proposed process with the TA and obtain TA approval to use the process.

Appendix D - CAF/Clo Determination Whitepaper

PRC-PRO-SH-121 is the document which governs Heat Stress controls. One of those controls is a set of correction factors dealing with the use of various ensembles of Personal Protective Equipment.

The correction factor used for this is called Clothing Adjustment Factor or CAF. Many of the CAFs found in PRO-121 are from the ACGIH TLV Booklet. These come from a number of sources and by the ACGIH's own admission are not based on a standardized calculation or test. The test parameters for CAF are not fixed nor have nationally recognized parameters. Some of them are based on professional judgment.

To reduce confusion and ensure some amount of consistency in the Clothing Adjustment Factors, a standardized adjustment factor must be used.

Clo is a specific clothing heat transference factor developed in the 1940's. This provides a standardized test procedure (ASTM) by which different clothing ensembles and materials can be compared.

Since Clo testing is based on an ASTM standard manufacturers tend to use it for testing clothing heat transference since there is repeatability and pedigree with the standard.

A standard work coverall or level D ensemble has a Clo of approximately 1. It also has a CAF of essentially 0. Cotton coveralls have the same Clo and CAF as a level D ensemble. These two ensembles (level D and cotton coveralls) are the base ensembles of the ACGIH WBGT Clothing Adjustment Chart.

Other ensembles are compared to cotton coveralls and level D clothing.

Not all clothing ensembles have had CAFs developed for them. But there needs to be a way to logically establish a CAF so they can be compared to other clothing ensembles. The following is the logic to be used when developing the clothing adjustment factors.

If two materials have the approximately the same Clo then they would logically have a similar CAF. If you make one higher then you would be adding a level of conservatism or safety factor with the use of the PPE. As an example polyvinyl acetate (PVA) clothing has a Clo which is very similar to that of a cotton coverall (PVA Clo = .70; Cotton Coverall Clo = 1.0).

If we find the CAF for Cotton Coveralls to be accepted by the ACGIH as 0.0, then it would be conservative to make the CAF for the PVA clothing to be 0.9. This introduces a small amount of conservatism into the discussion.

Appendix D - (Cont.)

There is a Clo factor for 2 pairs of PVA coveralls. This Clo is approximately 1.0 (0.99). Two pairs of cotton coveralls have a CAF of 4.5. If 4.5 is used for the CAF for two pairs of PVA coveralls then there would be the same conservatism used as was originally used for the 2 pair of cotton coveralls.

Other coverall ensembles are found in PRC-PRO-SH-121 and are basis the decision logic when establishing a CAF.

Appendix E - Use of Hanford Meteorological Station for WBGT measurements

A review of the requirements for monitoring WBGT on the work site has been performed due to an employee concern. This review focused on the requirements to perform WBGT monitoring directly at the worksite and whether the use of the Hanford Meteorological Station (Met Station) data is appropriate to use.

PRC-PRO-SH-121 is the controlling document for Heat Stress information in CHPRC. It describes how Heat Stress should be measured and how to interpret the information. The direction regarding heat stress measurements follows the recognized national standard for heat stress in ACGIH TLV & BEI Booklet, American Conference of Governmental Industrial Hygienists (ACGIH), "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices".

The employee concern focuses on multiple issues directly related to PRO-121 and each will be covered.

One concern was the use of the Met Station data as good WBGT data. The Met Station is approved source of WBGT data in a Note in Section 3.2 of PRO-121. The WBGT used is properly maintained and calibrated. This has been verified with MSA.

The Use of Met Station data for outdoor work has been an approved method of hazard identification for a number of years, both utilized and validated by multiple Hanford contractors. The Met Station uses a calibrated WBGT which provides a measurement that has a good deal of accuracy compared to the rest of the site. The use of met station data is best suited for field work away from buildings and structures and when work groups are in level D apparel.

The accuracy of the WBGT is within the normal tolerances expected for this piece of IH equipment.

It is not uncommon for two WBGT meters to provide readings which are several degrees apart. This variability could be due to the cleanliness of the thermometers and the globe as well as the ability of the wick to absorb and evaporate moisture. While it is true that WBGT heat measurements should be made at, or as close as possible to, the specific work area where the worker is exposed, it is also permissible to use measurements from WBGTs that are not on the work site provided the readings are representative of the employee's work area. Data collected by local WBGTs is comparable to the readings collected at the met station, i.e. within the accuracy range of the instruments, and in most cases, the met station data is more conservative.

The use of the WBGT should not be solely or overly relied upon to control heat stress. The WBGT measurement is used as a conservative tool to provide indications of potential heat stress issues. It cannot by itself identify heat stress issues but should be used with observations and personal awareness as a way to reduce the potential exposure to heat related illnesses.

There is a question in the employee concern regarding the collection and entry of WBGT data into SWIHD. OS&IH personnel enter the WBGT data that they collect during sampling activities and use that data to determine the proper controls to keep employees safe during work activities.

OS&IH does not collect Met Station WBGT information; it is obtained through contact with the Met Station. The Data is collected by the Met Station and the information is saved under MSA rules. Since CHPRC OS&IH does not collect the data it is note entered into SWIHD.

The information in some cases is received by a shift office that enters the data into their logs and the information they send out via the paging system which may be saved by project personnel.

Another question in the employee concern regards the accuracy of the Met Station as compared to WBGT measurements in the field. Included in this review is WBGT data from various areas of the site along with the corresponding Met Station WBGT data. This data indicates that there is very little variability between daily reading of a WBGT in the field with the works and the WBGT from the Met Station. The comparison of measurements is attached at the end of this White Paper.

No matter the convenience, Met Station WBGT results should only be used when employees are working outdoors in Level D ensembles, away from reflective surfaces and heat sinks such as concrete and asphalt or highly reflective surfaces.

Employees can request WBGT readings directly on the worksite if they have a concern. This information should be compared to the Met Station data so they can be compared and that comparison shared with the employees.

References:

PRC-PRO-SH-121, *Heat Stress Control*

ACGIH TLV & BEI Booklet (2005), *American Conference of Governmental Industrial Hygienists (ACGIH), "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices"*

ACGIH TLV & BEI Booklet (2007 edition)

DHHS (NIOSH) Publication Number 86-113, *Criteria for a Recommended Standard: Occupational Exposure to Hot Environments (Revised Criteria 1986)*, April 1986

OSHA Technical Manual (OTM) Section III: Chapter 4, *Heat Stress*