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1.0 PURPOSE AND SCOPE

(7.1.1, 7.1.2)

This procedure provides the requirements to identify, evaluate, and control worker heat stress in both indoor and outdoor work environments. The Heat Stress Control program is also required to assess the effectiveness of implemented controls. This Heat Stress Control program was prepared to meet the requirements described in the 2005 American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values for Chemical Substances, Physical Agents and Biological Exposure Indices, as specified by 10 CFR 851, "Worker Safety and Health Program."

This procedure applies to all Washington River Protection Solutions, LLC (WRPS) directed and subcontractor field activities where heat stress conditions may be involved. Subcontractors to WRPS shall define how they implement the roles and responsibilities within their organization according to their contract, but must utilize a WRPS Industrial Hygienist for heat stress control functions described in this procedure.

The procedure must be used for all work where heat stress is expected. This procedure does not apply to intermittent, light work with single layer permeable clothing (such as anti-c or street clothes) that takes less than 15 minutes - in a 60 minute period to complete (such as brief, non-repeated valve manipulation requiring little or no exertion), unless an Industrial Hygienist determines it is necessary.

The site medical provider evaluates individuals with potential heat strain related to heat stress events; however, certain medical services are outside the scope of this document, including:

- Medical intervention for treatment of heat stress illness by the first aid stations or medical providers
- Fitness-for-duty protocol or medical certification to perform work in hot environments.

2.0 IMPLEMENTATION

This procedure is effective on the date shown in the header.

3.0 RESPONSIBILITIES

3.1 Heat Stress Subject Matter Expert (SME)

- Provide guidance for and interpretation of the Heat Stress Control procedure
- Coordinate with the Heat Stress Technical Committee, External Affairs Department, and Safety & Health managers to develop and print a Solutions Newsletter article for heat stress mitigation during the month of May or as weather conditions dictate.
- Coordinate with the Safety & Health Managers and the Heat Stress Technical Committee to develop tailgate slides for company-wide presentation each week during the month of June or as weather conditions dictate.
- Verify that heat stress mitigation activities are properly performed.
- Lead and chair the Heat Stress Technical Committee.

- Stay abreast of current requirements, technologies and best practices for managing heat stress.

- Assess the effectiveness of this program and report to the Industrial Hygiene (IH) Program Manager annually with any recommendations for continuous improvement.

3.2 Area Maintenance Manager

Facilitate the annual kick off of warm weather activities by March 1. This includes:

- Coordinating with Mission Support Alliance (MSA) Refrigerated Equipment Services to ensure that required electrical and mechanical preventative maintenance is performed.

- Coordinating with line organizations to ensure that sufficient long lead heat stress mitigation equipment is available to support the summer work schedule.

- At the end of the high heat season, coordinating with line organization managers to ensure heat stress mitigation equipment is properly stored for future use.

3.3 Industrial Hygienist

- Participate in job hazard analysis and, when heat stress is expected, complete the Heat Stress Mitigation Checklist (A-6006-431) for each applicable work activity/task. Assist in the determination of equipment, personal protective equipment (PPE) & clothing, metabolic load and techniques that will be used to mitigate and monitor heat stress.

- Calculate Time-Weighted Averages reflecting work and rest exposures to thermal stress.

- Make the final decisions on determination of the applicable clothing protection factors, and work demand activity levels.

- Direct the implementation of physiological monitoring of workers as needed or required.

- Upon request, 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.

- Assist line management in applying heat stress exposure controls using the Heat Stress Mitigation Checklist (A-6006-431)

- Identify other factors that may alter the interpretation and use of the Heat Stress Mitigation Checklist (A-6006-431) and determine exposure limits accordingly.

- Provide written direction to Industrial Hygiene Technicians (IHTs) when modifications to the Heat Stress Mitigation Checklist (A-6006-431) are made.

- Investigate heat stress and strain cases.

- Support Line Management in determining acclimatization status of employees.

3.4 Industrial Hygiene Technician

- Evaluate field conditions for changes from planned conditions and make necessary adjustments to the work rest regimen based on Wet Bulb Globe Thermometer (WBGT) readings, level of impermeable PPE being used, metabolic activity and work schedules driven by Attachment A, Table A-3 Screening Criteria for Heat Stress Exposure.

- Communicate work-rest regimens, within the limits of Attachment A, Table A-3 Screening Criteria.

- Collect and document heat stress monitoring data on the Site-Wide Industrial Hygiene Database (SWIHD) field log for WBGT and/or A-6006-433 for Physiological Monitoring. Heat stress monitoring data should then be transcribed into SWIHD.

- Collect and document physiological monitoring data on Worker Heart Rate/Temperature Monitoring Form, (A-6006-4 33) and attach to the SWIHD survey.

- Obtain Industrial Hygienist approval for any increased heat stress conditions prior to implementing modified work/rest schedules.

3.5 Line Manager

- Understand the early signs/symptoms of heat-related disorders.

- Brief employees in heat stress recognition, prevention, and control.

- Ensure employees assigned to perform activities involving exposure to heat stress have been medically qualified.

3.6 Employees

- Participate in heat stress prevention activities (e.g., job hazard analysis, field condition review, pre-job briefing).

- Participate in physiological monitoring for heat stress, as directed by the Industrial Hygienist (unless there is a medical restriction).

- Be aware of means to avoid heat stress and the importance of adequate hydration.

- Select and wear personal clothing, as appropriate, to minimize body heat build-up (whether worn alone or in combination with work uniform).

- Wear appropriate PPE as required in the Heat Stress Mitigation Checklist (A-6006-431), work package, or Radiological Work Permits (RWPs) to minimize body heat build-up.

- Understand lifestyle factors that increase the risk of heat related disorders

- Recognize the signs and symptoms of heat related disorders.

- Use the ‘buddy system’ to self-monitor for signs and symptoms of heat related disorders.

- If signs or symptoms of heat stress develop, inform FWS and take appropriate action, such as immediately exiting the work area.

- Report changes in health status (illness, medications, etc.) that may affect their ability to work under heat stress conditions to their supervisor.

3.7 Field Work Supervisor

- Ensure that the designated work/rest regimen is followed; obtain Industrial Hygienist approval for any increased heat stress conditions prior to implementing modified work/rest schedules.

- Provide pre-job briefings emphasizing the recognition and control of heat strain.

- Ensure that specified controls for heat stress are implemented.

- Ensure that heat stress conditions are monitored using representative WBGT indicated on the heat stress mitigation checklist.

- Reference Attachment B, Field Work Supervisor Responsibility Summary.

3.8 Heat Stress Technical Committee

- Support Area Maintenance Managers and Line Management with seasonal heat stress preparation activities.

- Provide updates to HGET training and pre-job information for workers on heat stress precautions and general controls.

- Support the Heat Stress SME in developing lessons learned, Solutions articles and tailgates to support seasonal heat stress communications.

- Monitor the effectiveness of this program and provide feedback to the Industrial Hygiene Program Manager annually.

4.0 PROCEDURE

The Heat Stress Decision Chart (Figure 1) shall be followed by the Industrial Hygienist when any of the following conditions are met:

- A qualitative exposure assessment indicates the possibility of heat stress

- There are reports of discomfort due to heat stress

- IH professional judgment indicates heat stress conditions are likely

- If predicted dry bulb ambient temperature is above 85°F

- Impermeable clothing is used and if sufficient detailed data is not available
- Heavy to very heavy work demands are present.

4.1 Preparation for Heat Stress Conditions

Line Manager	1.	Ensure that personnel assigned to work in heat stress conditions have been identified for this work activity through the employee job task analysis process (TFC-ESHQ-S_IH-C-17).
	2.	Assume workers are un-acclimated unless they have documented an exposure history.
		a. Ensure that worker's Employee Job Task Analysis (EJTA) identifies if heat stress exposure is expected, and identification of any heat stress related work restrictions.
		b. Verify that workers have completed Hanford General Employee Training (HGET) and any updates which address thermal stress.
Field Work Supervisor	3.	Implement controls requiring long lead times for approval and purchase in a timely manner so that the control strategy will be available. (i.e., Special engineering controls, PPE designed for cooling, cooling/shade structures and changes to work schedules are examples of longer lead-time controls).
Industrial Hygienist	4.	Assist line management in the selection, and use of cooling devices or other protective equipment, as requested.

4.2 Identification and Evaluation of Heat Stress Conditions

Line Manager/ IH/Field Work Supervisor	1.	During work planning and field condition review, determine the potential for heat stress using a Heat Stress Mitigation Checklist (A-6006-431) for each applicable work activity/task.
Field Work Supervisor	2.	Notify IH if impermeable clothing or ensembles will be used.
Industrial Hygienist	3.	Evaluate use of impermeable clothing ensembles for potential contribution to heat stress.

IH/Field Work Supervisor

4. Assume heat stress may exist when any of the following risk factors are expected during the work activity. The Industrial Hygienists or Field Work Supervisor shall use the examples below to help determine if a heat stress condition exists.

   - High ambient temperatures, usually above 85°F dry bulb temperature,
   - High humidity; as indicated by WBGT readings above 75°F,
   - Work performed in greenhouses (containment tents) or other environments with minimal air movement that could result in heat buildup.
   - Heavy to very heavy metabolic work demands (especially where heavy clothing is worn),
   - Sources of radiant heat are present where employees will work (e.g., work on asphalt or roofs, work near steam pipes, boilers, heated vessels or in direct or reflected sunlight),
   - Direct physical contact with hot objects.

Field Work Supervisor

5. If any of the factors listed above are expected, consider rescheduling work to cooler times of the day or season.

6. If the work cannot be rescheduled, obtain Industrial Hygiene support to perform an evaluation of the work activity in accordance with Figure 1.

Industrial Hygienist

7. Indicate heat stress controls and monitoring requirements by completing the Heat Stress Mitigation Checklist form (A-6006-431) for each applicable work activity with heat stress potential and provide a copy to Line Management.

   - Standardized checklists using current data and evaluation may be used for routinely performed work.
   - Grouping of tasks for multiple activities with the same mitigation is permitted if tasks are identified on the checklist.

Line Manager/Field Work Supervisor

8. Work with the IH to determine which suggestions on the heat stress mitigation checklist are appropriate.

9. If a significant amount of time has elapsed between the preparation of the Job Hazard Analysis or work planning documents and the work, re-evaluate the weather conditions to ensure the heat stress hazards are adequately addressed.

4.3 Applying Heat Stress Control Strategies – Hierarchy of Controls

1. Engineering controls. Engineering controls such as cooling stations, air conditioners, swamp coolers, and overhead shade shall be used as the primary method to reduce heat stress. If engineering controls are not feasible, then administrative controls shall be used to reduce the exposure to heat stress. Personal protective equipment shall be selected when engineering and administrative controls may not be effective alone.

   Engineering controls should be planned for and prepared in advance of work to ensure work schedules are not delayed.

2. Low risk controls. Where the evaluation of heat stress potential does not indicate likely heat stress to be present. If conditions are <85°F dry bulb, or < 75°F WBGT and no more than level D work clothing is required and metabolic activity is light to moderate, no specific controls are required. However, the following best practices are encouraged to minimize heat stress potential:

   - Self-monitoring and reporting of heat stress becoming uncomfortable
   - Use the 'buddy system' to monitor for signs and symptoms of heat stress
   - Implement controls identified on the Heat Stress Mitigation Checklist (A-6006-431). If additional controls are deemed necessary, the Checklist must be revised before continuing work.

3. General controls. In addition to controls listed above, and where evaluation of heat stress is at or below the screening table values (Attachment A, Table A-3) for either acclimated or un-acclimated workers the following controls are required:

   - Pre-job briefings and HGET training covering heat stress
   - Implement controls identified on the Heat Stress Mitigation Checklist (A-6006-431). If additional controls are deemed necessary, the Checklist must be revised before continuing work.

   The following best practices are recommended:

   - Encourage hydration
   - Encourage health fitness goals.

4. Job specific controls. In addition to the controls listed above, and where the evaluation of heat stress is above screening criteria table values (Attachment A, Table A-3) for either acclimated or un-acclimated workers, the following controls are required:

   - Implement the hierarchy of controls beginning with engineering controls
   - Consider administrative controls to set acceptable exposure times, and provide for sufficient recovery and limit physiological strain
   - Consider lower heat stress producing personal protective equipment

- The IH must determine if sufficient detailed data is available or if physiological monitoring is necessary to evaluate the worker heat stress exposure and to evaluate the effectiveness of the selected controls in reducing heat stress. Physiological monitoring is required for impermeable clothing ensembles such as polyethylene coated Tyvek or vapor barrier coveralls if sufficient detailed data is not available.

- For the use of air conditioned controls in a radiologically controlled area, see TFC-ESHQ-RP_ADM-CD-21.

- Implement controls identified on the Heat Stress Mitigation Checklist (A-6006-431). If additional controls are deemed necessary, the checklist must be revised before continuing work.

4.4 Implementation and use of the Heat Stress Control Decision Logic that Requires Physiological Monitoring

Industrial Hygienist

1. Assist Line Management in implementing controls from the Heat Stress Mitigation Checklist (A-6006-431) and Guidance for Establishing Work/Rest Regimen (Table A-1).

2. Evaluate and document the basis for heat stress control using the Heat Stress Mitigation Checklist (A-6006-431)

3. Determine heat stress levels expected. If work and rest environments are different, or when work demands vary within the hour, then an hourly time weighted average should be used.

4. If work will occur that is outside of the work/rest schedule as established in Box 7 of Figure 1.

   a. Perform an evaluation of the situation (box 5).

   b. Determine if detailed data is available that could be used to estimate the heat stress potential (box 10).

   c. If data is available which the IH determines is appropriate for the work being evaluated, implement the appropriate Attachment A, Table A-3 work rest regimen (box 7).

   d. Determine if NO detailed data is available that could be used to estimate the heat stress potential (box 10).

   e. Implement initial work/rest controls (box 11) starting with a 25/75 work rest regimen. Either continuous physiological monitoring is required (box 12), or at a minimum, periodic monitoring at no more than 30 minute intervals until the IH determines sufficient detailed data is available to develop a work/rest schedule.

   f. Assess the results of the physiological monitoring (box 13) and use the results to re-evaluate how to implement job specific controls (box 11) if the task is to continue, or to document detailed data for other similar heat stress control work. The IH may continue to direct physiological monitoring, use the detailed data to apply the work/rest regimen in Attachment A, Table A-3 work rest regimen Table A-3 or develop and implement additional controls to effectively control worker exposure to heat stress.

4.5 Applying Heat Stress Control Strategies – Daily Work Management

Line Management/ Field Work Supervisor

1. Ensure work performed in heat stress conditions is under the direction of a supervisor who knows the early signs/symptoms of heat related disorders and who shall enforce the assigned work/rest regimen and other established controls described in the Heat Stress Mitigation Checklist (A-6006-431).

2. Recognize any worker medical work restrictions that could increase sensitivity to heat stress.

3. Ensure water/fluids are provided and accessible to employees as requested and whenever there is a potential for heat stress conditions to exist. Recommended intake is 8-ounces (1 cup) of cool water (10-15°C or 50-60°F) every 15-20 minutes; Salt tablets are not recommended. For providing water in a radiological contamination area, see TFC_ESHQ-RP_MON-C-22.

4. Communicate to the affected personnel during the pre-job briefings the planned use of heat stress mitigation techniques and then ensure that the additional heat stress monitoring or control strategy specified in the work planning process is implemented (physiological monitoring, personal protective equipment, controls for heat stress, etc.).

5. Establish and communicate during the pre-job briefing the location of rest areas.

6. Monitor field implementation of controls as required by the Heat Stress Mitigation Checklist. Work may not proceed if required controls are not in place or functioning.

Industrial Hygienist

7. Support Line Management in determining worker acclimatization status in accordance with Attachment C. If conditions are below the chart values, then heat stress conditions are no longer expected and the Heat Stress Mitigation Checklist (A-6003-431) would no longer apply.

4.6 Heat Stress Monitoring

The simplest form of monitoring is self-reporting of perceived heat stress and use of the 'buddy system' to help monitor for early signs and symptoms.

WBGT monitoring measures the conditions of the work environment indicating the contributions of heat sources and humidity. WBGT monitoring functions as a screening tool for worker safety and is used to determine the work-rest regimen (Attachment A, Table A-3). WBGT monitoring results measure environmental conditions and shall not be relied upon as a direct measure of worker heat stress. When clothing ensembles restrict evaporative cooling the micro-climate between the skin and clothing increase heat stress to the worker. The clothing adjustment factors (Attachment A, Table A-1) must be used with the guidance for establishing work/rest regimens in Attachment A, Table A-3.

Physiological monitoring measures the level of an individual's heat strain in response to heat stress conditions. Physiological monitoring will be conducted using an IH approved device following manufacturer's instructions (e.g., Nonin Onyx® heart rate monitor, infrared tympanic membrane thermometer or other monitor approved by the IH Programs Group). Physiological monitoring is required for heat stress above the screening criteria table values (Attachment A, Table A-3) for impermeable clothing ensembles such as polyethylene coated Tyvek or vapor barrier coveralls if sufficient detailed data is not available.

4.6.1 Work/Rest Regimen

Work/Rest regimens will be established through the use of WBGT monitoring, determination of work activity levels, applicable clothing protection factors and may include physiological monitoring. The following are responsibilities for individuals in determining the applicable work/rest regimen schedules.

Industrial Hygienist

1. As needed, provide guidance to the IHT/Line Manager/Field Work Supervisor to develop the work-rest regimen. This may include:

		• Calculation of time weighted averages reflecting work and rest period exposures to thermal stress • Work demands, determination of the metabolic rates associated with tasks. • Clothing adjustment factors not listed in Table A-1 • Acclimatization status, in accordance with Attachment C • Physiological monitoring
Industrial Hygiene Technician	2.	Contact the Field Work Supervisor and notify the IH when: • Any worker exhibits signs or symptoms of excess heat stress or heat strain, or • The work-rest regimen reaches the 50/50 work/rest regimen; work may proceed while notification is made, or • Work activities that cannot be conducted within the work-rest regimens found in Attachment A, Table A-3 must require physiological monitoring to continue work activities. If work outside the Work/Rest Regimen in Attachment A, Table A-3 will be conducted, the IH or their designated alternate must be contacted before work may proceed.
Line Manager/Field Work Supervisor/ Industrial Hygiene Technician	3.	Implement the Work/Rest Regimen using the information provided by the Industrial Hygienist and in accordance with Attachment A, Table A-3 and applying the clothing adjustment factors from Attachment A, Table A-1.
Field Work Supervisor/ Industrial Hygiene Technician	4.	Notify the Industrial Hygienist when the work-rest regimen reaches the 50/50 work/rest level; work may proceed while notification is made.
Field Work Supervisor	5.	Ensure the IHT is monitoring WBGT conditions using a representative WBGT.
	6.	Where work site WBGT monitoring is unspecified, and where the work is expected to be light to moderate intensity, general WBGT data from the U.S. Department Of Energy (DOE) Hanford Meteorological Station or the nearest WBGT device may be used to estimate the WBGT values for some outdoor activities, as specified by the IH on the Heat Stress Mitigation Form. For site meteorological data, see: http://www.hanford.gov/hms.

4.6.2 WBGT Monitoring

WBGT monitoring should be conducted when:

- Ambient temperatures are forecasted to be >85°F dry bulb, or
- Heat stress risk factors listed in section 4.2.4 are present, or
- When requested by Field Work Supervisor, or
- If required by the Industrial Hygienist.

WBGT monitoring is not required if physiological monitoring is used as the primary method to evaluate heat stress controls for all individuals working a specific job. WBGT monitoring is required under the above conditions for personnel not being physiologically monitored, such as support personnel, to evaluate heat stress controls and establish work/rest cycles as determined by the Industrial Hygienist. FWS needs to ensure adequate IHT support.

WBGT readings shall be collected at the location(s) specified in the Heat Stress Mitigation Checklist (A-6006-431) at least every hour (or less if IH determines it necessary). WBGT should be placed to obtain information representative of the worker(s) being monitored.

4.6.3 Physiological Monitoring

The Industrial Hygienist will ensure physiological monitoring is performed in situations where:

- WBGT monitoring is not feasible
- Work will occur that is outside of the work/rest regimens identified in Attachment A, Table A-3
- Additional information on worker heat stress is needed to evaluate the effectiveness of controls, assess clothing protection factors or provide detailed data for evaluation
- Work will occur in a full set of impermeable clothing ensembles such as polyethylene coated Tyvek or vapor barrier coveralls

NOTE: Physiological monitoring must be performed for work occurring outside the work/rest regimens identified in Attachment A, Table A-3 or for work in impermeable clothing ensembles unless a detailed analyses method appropriate to the work conditions or clothing requirements is utilized by the IH.

Industrial Hygiene Technician

1. Contact the Field Work Supervisor and the IH when any of the following conditions are present:

   - If heart rate, taken after 1 minute in recovery area, continues to rise following a sustained target heart rate
   - If recovery heart rate cannot be attained by a worker after two rest periods, or a body core temperature >100.4 F is measured
   - Any worker exhibits signs or symptoms of excess heat stress or heat strain.

2. Complete all pre-work, information as necessary for each employee for whom monitoring will be conducted and record on the Official Use Only, Worker Heart Rate/Temperature Monitoring Form (A-6006-433).

NOTE: Either heart rate or body core temperature may be collected; it is not necessary to collect both.

Field Work Supervisor/ Industrial Hygiene Technician

3. The IHT shall collect and document on the Worker Heart Rate/Temperature Monitoring Form (A-6006-433) each employee's heart rate, or body core temperature.

   - Target heart rate = 180 minus the person's age.
   - Example: for a 44-year old person, their target heart rate would be 136 beats per minute (180 bpm – 44 bpm = 136 bpm).

4. If the worker's pre-work resting heart rate is greater than 110 bpm, or if the body core temperature is > 100.4 degrees F, notify FWS and contact IH, and obtain approval by the occupational medical provider before allowing him/her to work in a heat stress environment. (Re-measurement of the resting heart rate or body core temperature can be made if the first reading was not representative of the worker's resting heart rate.)

NOTE: Unless otherwise indicated on the release/return to work Record of Visit (ROV), individuals released to return to work without restriction may return to work and utilize approved, alternative methods for physiological monitoring.

5. If the workers' body core temperature is > 100.4 F, as measured at the tympanic membrane of the ear, then excessive heat strain may be present and exposure to heat stress must be discontinued. The worker is required to go to a rest area.

6. Conduct and document work place heat stress related environmental and/or personal measurements (i.e., WBGT index, worker body core temperature, and continuous [Polar H 7] or periodic [Nonin] heart rate monitoring).

7. Heart rates are taken with continuous (Polar H7) or periodic measurements (Nonin) of the heart rate and body core temperature at a frequency of no greater than 30 minutes (monitoring intervals less than 30 minutes may be required by the Industrial Hygienist). Record data as indicated above, and make appropriate notifications as directed by the Industrial Hygienist.

NOTE 1: Once resting heart rates are taken, monitoring is required every 30 minutes once work begins. If lunch period falls outside the 30 minute window, resting heart rate will need to be taken after the lunch period ends before work resumes to restart the 30 minute cycle.

NOTE 2: The target rate is not a peak heart rate limit. It can be exceeded momentarily without adverse health effects in a population with medically assessed normal cardiac performance.

8. If the heart rate is a sustained heart rate, workers are required to be removed to a rest area.

9. If continuous heart rate monitoring (Polar H7) determines that an individual(s) has exceeded their target heart rate and is sustained, the individual is required to be informed at that time and shall begin a rest period for 15 minutes in a rest area.

   If periodic heart rate monitoring (Nonin) is utilized, three separate measurements, separated by 1 minute between each measurement, shall be taken to indicate a sustained measurement (2 minutes), and the worker is required to take a 15 minute rest in a rest area.

   If a body core temperature reading of 100.4 degrees F is exceeded, the worker is required to stop and go to the rest area for 15 minutes.

   NOTE: Workers can request their heart rate reading or body core temperature at any time during the survey.

4.6.4 Rest Periods

The goal of the 15 minute rest period is to reduce the worker's heart rate to below 110 bpm prior to re-starting work.

Industrial Hygiene Technician

1. After the 15 minute rest period, and before resuming work, check and record the worker's heart rate or body core temperature.

   - If the worker's heart rate is less than 110 bpm, or their body core temperature is < 100.4 degrees F, work can begin again.

- If the worker's heart rate is greater than 110 bpm, or their body core temperature is > 100.4 degrees F, require the person to rest for another 15 minutes.

- If a worker's heart rate does not recover to less than 110 bpm, or their body core temperature to < 100.4 degrees F after the second 15 minute rest period, the worker is not allowed to return back to work. Notify the FWS and the Industrial Hygienist. Additionally, depending on circumstances, the individual, the FWS, and/or industrial hygienist may decide that medical attention is necessary.

- The rest periods should be conducted near the work area in a shaded, ventilated, or cooler than work location. Cool water should also be available.

4.7 Post-Survey

Industrial Hygiene Technician	1. Complete all required forms and provide them to the Industrial Hygienist in accordance with TFC-ESHQ-S_IH-C-46 and TFC-ESHQ-IH-STD-03.

5.0 DEFINITIONS

Acclimatization. The adaptation to thermal stress by the body. Acclimatization is a gradual physiological adaption that improves an individual's ability to tolerate heat stress. The development of full-heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions (activity metabolic level and clothing) similar to those anticipated for work. Acclimatization noticeably decreases after 4 days after the activity under heat-stress conditions is discontinued.

Body Core Temperature. The temperature of the internal core body. Both ACGIH and National Institute for Occupational Safety and Health (NIOSH) cite a body core temperature of 100.4°F as the limit for un-acclimatized workers or 101.3°F for acclimatized workers for daily, prolonged work under heat stress conditions. Body core temperature can only be indirectly measured in the field.

General Controls. Provide instructions and precautions on recognizing and avoid heat stress and strain. Encourage frequent hydration about every 20 minutes, encourage use of the buddy system and monitoring of signs and symptoms of heat strain. When possible, provide designated rest areas for cooling and hydration.

Heart (Pulse) Rate Monitoring. Monitoring an individual's heart rate (beats per minute) to determine the physiological effect resulting from exposure to heat stress and the individual's recovery rate after one minute of discontinuing exposure.

Heat Strain. Physiological response to heat stress recognized by: increased core body temperature, increased heart rate or sweating. If these responses are uncontrolled, these

symptoms may progress and result in increased incidence of heat stress disorders, increased accident rates and irreversible physiological conditions.

Heat Stress. The net heat load on the body that results from exposure to external sources and 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 stress include air temperature, humidity, radiant heat exchange, and air movement. As heat stress approaches a worker's tolerance limits, the risk of heat related disorders increases.

Hot Environment. A work area where one or more of the following factors may exist, creating the potential for heat stress: igh temperature/humidity, sources of significant radiant heat, use of protective clothing that insulates or impedes sweat evaporation, or dry bulb temperatures in excess of 85°F.

Impermeable Clothing. Impermeable protective clothing prevents or resists water vapor, air movement or convective heat losses. Permeability ranges vary with specific types of PPE, but all protective clothing provides insulation, reduces water vapor transfer and air movement to some extent. Partial body coverage as sleeves, head coverings, gloves, boots or aprons may provide decreased heat stress depending on how they are used. Covering the head, large muscle groups doing high exertion or areas that are well supplied with blood or sweat glands can still result in substantial heat stress. Impermeable clothing ensembles include those that are "semi-permeable" barriers to water vapor or air movement, encapsulating suits, or multiple layers; the use of these ensembles will result in a need for physiological monitoring.

Job Specific Controls. Any combination of engineering, administrative and personal protective equipment controls to reduce heat stress to an acceptable level. Monitoring to evaluate the effectiveness of the controls and worker exposure is necessary.

Level D Clothing. Minimum basic level of personal protection equipment used in the tank farms or areas or operations where no air contaminants are present that would require respiratory protection. Specific PPE requirements will be determined by hazards associated with the work activity and may be used as appropriate. These may include: coveralls, anti-contamination clothing (as determined by HP), safety glasses or goggles, substantial footwear or protective footwear, hard hat, hearing protection, gloves.

Low Risk Controls. General HGET training along with minimal controls for low exertion work where no more than level D clothing, and where environmental conditions for heat stress are not expected.

Modesty Clothing. Clothing worn beneath work garments which can include shorts, tee shirts, company-provided surgical apparel (scrubs) or other personal apparel which provides modesty in the event work garments must be removed.

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 & temperature measurement. It does not include parameters which may be considered medical monitoring such as measurement of blood pressure, oxygen saturation, or cardiac rhythm.

Recovery Heart Rate. Worker heart rate, taken initially after 1 minute in a recovery period, and after a 15 minute period, and possibly again after a second recovery period. Measurement that must be less than 110 beats per minute in order for worker to return to work. If the measurement is over 110 beats per minute, then a second 15 minute recover period is started. If after the second recovery period the measurement is below 110 beats per minute, the worker may return to work. If not, the worker must be removed from the work area, and the FWS and IH must be notified.

Resting Heart Rate. Worker heart rate while at rest in a work area. Utilized to allow the worker to enter the work site and/or to return to work.

Rest. Includes sitting with moderate arm movements in the same environment as the work activity.

Rest Area. An 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, ventilated, have drinking water available, and allow for an employee to sit and partially doff protective clothing when practical.

Sustained Heart Rate. Worker heart rate that rises above the target heart rate and stays above the target heart rate for at least two minutes.

Target Heart Rate. Maximum heart rate allowed for each worker at a work site. Target heart rate is determined by subtracting the worker's age from 180.

Threshold Limit Values (TLV) for Heat Stress. ACGIH values incorporate work exertion level, personal protective equipment in use, and WBGT temperatures to determine a work/rest regimen that permit nearly all workers to be repeatedly exposed to hot work environments without adverse health effects. Threshold limit values are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and dietary salt intake should be able to function effectively under the given working conditions without exceeding a core body temperature of 100.4°F for un-acclimated workers.

Wet Bulb Globe Temperature. Environmental temperature index used to assess the potential for heat stress. 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. The WBGT factors radiant heat, ambient dry bulb temperature and humidity into a single value. WBGT values measure environmental heat load exposure, but do not predict the microclimate inside protective clothing.

Wet Bulb Globe Thermometer. The device used to measure heat stress. Portable station or fixed meteorological readings are used to factor in ambient temperature, radiant heat and humidity. Use of this device measures environmental conditions contributing to worker heat stress, but is not a reliable measure of the microclimate inside of impermeable personal protective clothing.

Work/Rest Regimen. The proportion of time that an individual spends working and resting during one hour increments, and is established based on the WBGT index, work activity level (workloads), work clothing worn, personal protective equipment worn, and acclimatization status.

Work Week. For the purposes of determining acclimatization, a full work week for thermal stress exposure is the completion of 40 hours of shift work on a schedule similar that anticipated for the planned work. Work weeks may be separated by no more than 3 days, for counting as continuous weeks of exposure to thermal stress.

6.0 RECORDS

The following records may be generated during the performance of this procedure:

- Industrial Hygiene WBGT Field Log (A-6004-079) *
- Industrial Hygiene Continuation Form (A-6004-020) *
- Heat Stress Mitigation Checklist (A-6006-431)
- Heat Stress Acclimatization Determination Worksheet (A-6006-432)
- Worker Heart Rate/Temperature Monitoring Form (A-6006-433)
- Heat Stress Field Monitoring Form (A-6006-434)
- Industrial Hygiene Technician's Monitoring Field Notes

* These site forms are to be used as backup when the Site-Wide Industrial Hygiene Database (SWIHD) is unavailable. When the database is available, the information on the forms is to be transcribed into the database.

Site forms shall be attached to the SWIHD survey. Upon completion of the survey in SWIHD, an IDMS record will automatically be generated, capturing the survey and attachments for long term retention.

The record custodian identified in the company Records Inventory and Disposition Schedule (RIDS) is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02 and TFC-ESHQ-S_IH-C-46.

7.0 SOURCES

7.1 Requirements

1. 10 CFR 851, "Worker Safety and Health Program."

2. American Conference of Governmental Industrial Hygienists (ACGIH), "Threshold Limit Values for Chemical Substances, Physical Agents and Biological Exposure Indices," 2005.

7.2 References

1. 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response."

2. 29 CFR 1926.10(a), "Scope of Subpart."

3. 29 CFR 1926.65, "Hazardous Waste Operations and Emergency Response."

4. National Fire Protection Association Standard 70E for Electrical Safety in the Workplace, 2009.

5. TF-OPS-IHT-007, "Using Direct Reading Instruments."

6. TF-OPS-IHT-022, “Use of the Braun ThermoScan IRT 3020 Heat Stress Monitors.”

7. TF-OPS-IHT-012, “Preparation and Field Use of the QUESTemp 15 and QUESTemp 32 Heat Stress Monitors.”

8. TF-OPS-IHT-021, “Physiological Monitor with the Nonin Onyx and Vantage 9590.”

9. TF-OPS-IHT-025, “Physiological Monitor with Polar H7 Heart Rate Sensor.”

10. TFC-BSM-IRM_DC-C-02, “Records Management.”

11. TFC-ESHQ-IH-STD-03, “Exposure Monitoring, Reporting, and Records Management.”

12. TFC-ESHQ-RP_ADM-CD-21, “Radiological Controls for Heat and Cold Mitigation.”

13. TFC-ESHQ-RP_MON-C-22, “Drinking in a Contamination Area or Radiological Buffer Area.”

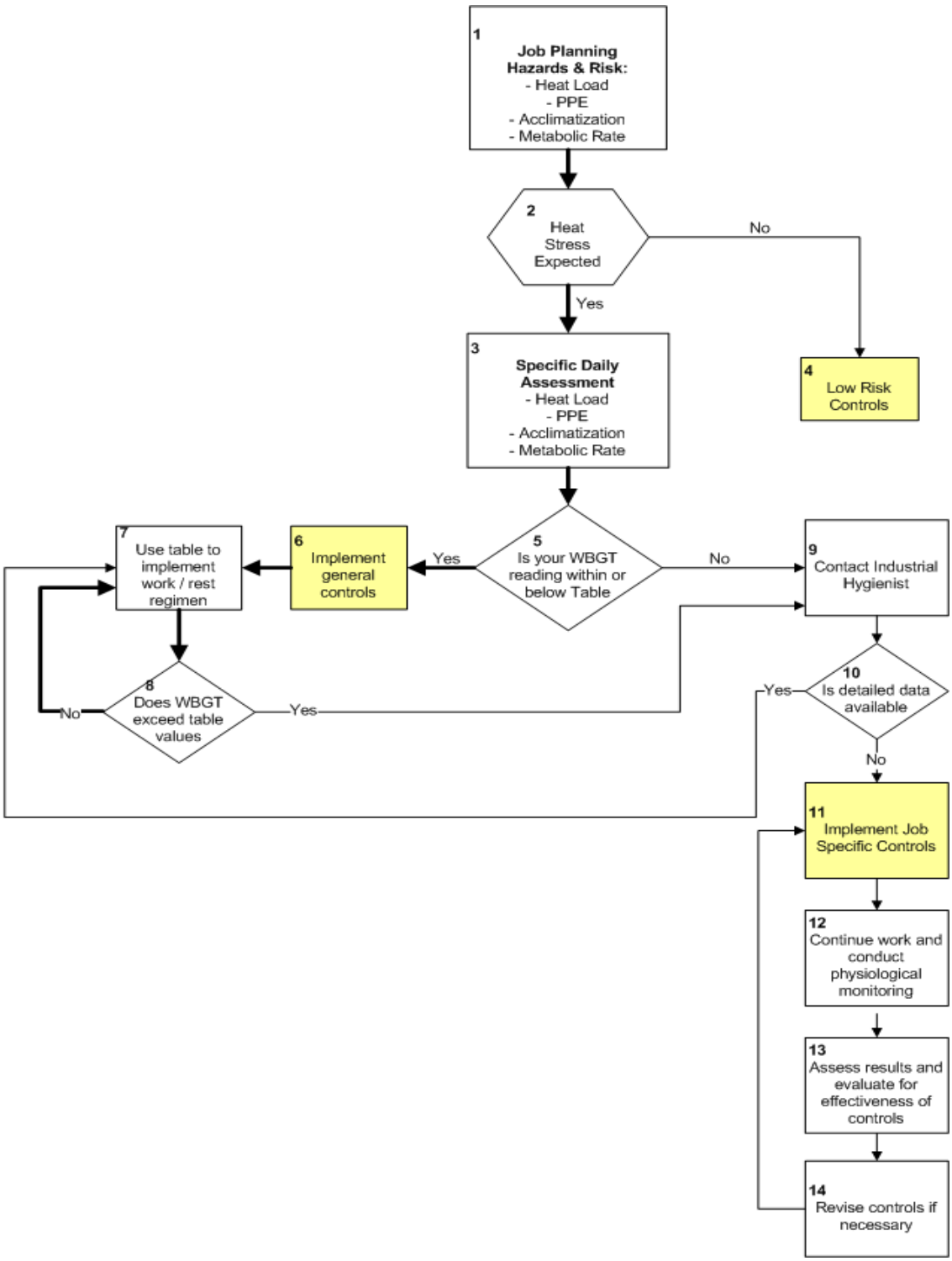
14. TFC-ESHQ-S_IH-C-17, “Employee Job Task Analysis.”

15. TFC-ESHQ-S_IH-C-46, “Industrial Hygiene Reporting and Records Management.”

16. TFC-OPS-MAINT-C-02, “Pre-Job Briefings and Post-Job Reviews.”

Figure 1. Heat Stress Control Decision Logic.

The Figure boxes are numbered for reference



ATTACHMENT A – GUIDANCE FOR ESTABLISHING WORK/REST REGIMENS

NOTES:

- Protective clothing that restricts air movement, evaporation or which provides thermal insulation. The clothing adjustment factors estimate the relative degree of heat stress expected to be experienced when wearing the protective clothing. Clothing factor adjustments for specific clothing ensembles may be determined after technical review by the industrial hygienist.
- These factors are added to WBGT values and then used as input when using Attachment A for establishing work rest regimens.
- Modesty clothing shall be worn under work garments.

Table A-1. Clothing Adjustment Factors (CAF).

Example Clothing Ensembles	CAF in °F
Level D work clothes (e.g., blue coveralls)	0
Single-layer ProTech Plus® 2000 coveralls[4]	0
Hood	+1.8
Single layer coveralls (e.g., anti-contamination clothing over modesty clothing)	+3.5
Double layer coveralls (e.g., 2 layers of anti-contamination clothing over modesty clothing)	+5
Flame Retardant (FR) Clothing (e.g. Electrical (Orange) single pair over modesty clothing, face shield and flame retardant hood)[3]	+5
Polyethylene coated Tyvek® w/hood[1]	+18.0
Vapor-barrier coveralls (e.g., vinyl rain suits) [2]	+19.8

[1] Bernard, T., et al, WBGT Clothing Adjustments for Four Clothing Ensembles Under Three Relative Humidity Levels, Journal of Occupational and Environmental Hygiene, 2:251-256, 2005.

[2] Bernard, T., et al, Effects of Hoods and Flame Retardant Fabrics on WBGT Clothing Adjustment Factors, Journal of Occupational and Environmental Hygiene, 5:59-62, 2008.

[3] Bernard, T., Heat Stress and Protective Clothing: an Emerging Approach from the United States, Ann. Occup. Hyg., 43:321-327, 1999.

[4] Hornibrook, C., Heat Stress Management Program for Power Plants, Electric Power Research Institute (EPRI), Table 2-1, Issued 1991, Finalized July 1998, made public October 1, 2008.

ATTACHMENT A – GUIDANCE FOR ESTABLISHING WORK/REST REGIMENS (cont.)

Table A-2. Estimating Work Activity Levels.

Work Demand	Metabolic Rates (watts)	WRPS Task Examples* (assuming 100% work at this level)
Resting	115	Pre-job meetings Rest periods in cooling tent Observing work being performed Note taking, recording information
Light	180	JHA walk down Gauge / Chart readings Lock and tag verification Minor electrical checks LOW / MDL Performing video inspections once equipment installed Operator rounds HPT routines / surveys / air sampling IHT monitoring/sampling
Moderate	300	Retrieval valve manipulation / alignment operations Pit work Breather filter change out Vent and balance Climbing ladders / scaffold a few times per shift (dance floor) Grab sampling Camera work – hauling cables and equipment and install Operating electrical power tools. Operating fork lifts Hauling laundry bags Mixing paints, adhesives, etc…
Heavy	415	Riggers hauling scaffold / set up Carpenters moving / sawing / hauling Shoveling dry material / hand excavation Torqueing bolts/breaking flanges Operators manual hauling of “pigs” for waste samples Construction using jackhammer Teamsters hauling furniture or large items Well drillers – moving encasements Welding, grinding, sanding
Very Heavy	520	Hand shoveling wet sand

* These examples are based on continuous work at anticipated exertion levels for these tasks. Due to the varying nature, frequency, and duration of tasks performed each work evolution must be independently evaluated for appropriate work demand.

ATTACHMENT A – GUIDANCE FOR ESTABLISHING WORK/REST REGIMENS (cont.)

- In accordance with interpretive guidance from the American Conference of Government Industrial Hygienists, no correction factors will be applied to workers wearing air purifying or air-line respirators.

- Self-contained breathing apparatus (SCBA) usage increases the Work Demand (work load) one category for the proposed work activity.

Table A-3. Screening Criteria for Heat Stress Exposure (WBGT values in F°).

	Unacclimated				Acclimated			
Work Demands	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
100% Work	≤81.5	≤77.0	≤72.5	*	≤85.1	≤81.5	≤78.8	*
75% Work 25% Rest	81.6 - 84.2	77.1 - 79.7	72.6 - 76.1	*	85.2 - 86.9	81.6 - 83.3	78.9 - 81.5	*
50% Work 50% Rest	84.3 - 86.0	79.8 - 82.4	76.2 - 79.7	≤77.0	87.0 - 88.6	83.4 - 85.1	81.6 - 83.3	≤81.5
25% Work 75% Rest	86.1 - 87.8	82.5 - 84.2	79.8 - 82.4	77.1 - 79.7	88.7 - 90.5	85.2 - 87.8	83.4 - 86.0	81.6 - 85.1

* Because of the physiological stress associated with Very Heavy work among less fit workers regardless of WBGT, criteria values are not provided for continuous work and for 75% work in an hour. The screening criteria are not recommended, and a detailed analysis and/or physiological monitoring shall be used.

- Table values assume:
  - Eight-hour work days in a five day work week with conventional breaks;
  - Rest is in a shaded, ventilated environment
  - Protective equipment used to reduce heat exposure is not worn.
- The Work-Rest regimen:
  - Starts with the work phase followed by the rest phase (i.e., progress from 100% work to 75% work, followed by 25% rest).
  - Is evaluated hourly and adjusted as necessary (i.e., the work-rest phases, shall total no more than 1 hour in length).
- Rest areas should allow for a decrease in body core temperature via shade, cooling mechanisms, removal of PPE, seating, fans, etc. when possible, in addition to proper hydration.

ATTACHMENT B - FIELD WORK SUPERVISOR (FWS) RESPONSIBILITY SUMMARY

1. Ensure that a Heat Stress Mitigation Checklist (A-6006-431) has been prepared and approved by an Industrial Hygienist (IH) for each applicable work activity/task to be performed. (Section 3.7; Section 4.2, Step 1)

2. Provide pre-job briefings to effected personnel emphasizing recognition and control of heat strain and planned use of heat mitigation techniques. (Section 3.7; Section 4.5, Step 3; Section 4.5, Step 4)

3. Ensure that the designated work/rest regimen is communicated to workers and followed. (Section 3.7)

    a. Notify the IH when the work-rest regimen reaches the 50/50 work/rest level. (Section 4.6.1, Step 5)

    b. Obtain IH approval for any increased heat stress conditions prior to implementing modified work/rest schedules. (Section 3.7)

4. Ensure that controls specified during the work planning process, including the Heat Stress Mitigation Checklist, for heat stress are implemented. (Section 3.7; Section 4.2, Step 8; Section 4.3)

    a. Implement controls requiring long lead times for approval and purchase in a timely manner so that the control strategy will be available. (i.e., special engineering controls, PPE designed for cooling, cooling/shade structures and changes to work schedules are examples of longer lead-time controls). (Section 4.1, Step 3)

    b. Notify IH if impermeable clothing or ensembles will be used. (Section 4.2; Step 2)

    c. Assume heat stress may exist when risk factors such as the following are expected: (Section 4.2, Step 4)

        - High ambient temperatures, usually above 85°F dry bulb temperature
        - High humidity; as indicated by WBGT readings above 75°F
        - Work performed in greenhouses (containment tents) or other environments with minimal air movement that could result in heat buildup
        - Heavy to very heavy metabolic work demands (especially where heavy clothing is worn),
        - Sources of radiant heat are present where employees will work (i.e. work on asphalt or roofs, work near steam pipes, boilers, heated vessels or in direct or reflected sunlight)
        - Direct physical contact with hot objects

5. If any of the above factors are expected, consider rescheduling work to cooler times of the day or season. If the work cannot be rescheduled, obtain Industrial Hygiene support to perform an evaluation of the work activity in accordance with Figure 1. (Section 4.2, Step 5; Section 4.2, Step 6)

ATTACHMENT B – FIELD WORK SUPERVISOR (FWS) RESPONSIBILITY SUMMARY (cont.)

a. Ensure water/fluids are provided and accessible to employees as requested and whenever there is a potential for heat stress conditions to exist. Recommended intake is 8-ounces (1 cup) of cool water (10-15°C or 50-60°F) every 15-20 minutes; salt tablets are not recommended. (Section 4.5, Step 2)

b. If a significant amount of time has elapsed between the preparation of the Job Hazard Analysis or work planning documents and the work, re-evaluate weather conditions to ensure heat stress hazards are adequately addressed. (Section 4.2, Step 9).

6. Ensure that heat stress conditions are monitored and recorded at least hourly. (Section 3.7; Section 4.5, Step 1; Section 4.6; Section 4.6.1, Step 7)

a. Ensure that heat stress conditions are monitored using a representative WBGT or, if an IHT is present on the job, arrange for the IHT to perform WBGT or worker physiological monitoring as needed. Ensure data is recorded on Heat Stress Field Monitoring Form (A-6006-434). (Section 4.6, Step 2)

b. Ensure periodic measurements of the heart rate and/or temperature at a frequency of no greater than 30 minutes are performed (monitoring intervals less than 30 minutes may be required by the Industrial Hygienist). Ensure data is recorded on the Worker Heart Rate/Temperature Monitoring Form (A-6006-433), and make appropriate notifications as directed by the IH. (Section 4.6.3, Step 7)

If the worker's pre-work resting heart rate is greater than 110 bpm, verify approval by the occupational medical provider before allowing him/her to work in a heat stress environment (re-measurement of the resting heart rate can be made if there is some question about the representativeness of the initial measurement). (Section 4.6.3, Step 7)

If heart rate monitoring determines that an individual(s) has exceeded their target heart rate and it is sustained, the individual is required to be informed at that time and shall begin a rest period for 15 minutes. Workers can request their heart rate reading at any time during the survey. (Section 4.6.3, Step 9; Section 4.6.7, Step 10)

If the workers' body core temperature is > 100.4 F, as measured at the tympanic membrane of the ear, then excessive heat strain may be present and exposure to heat stress must be discontinued and begin a rest period. (Section 4.6.3, Step 5)

c. Ensure work and rest times are documented.

ATTACHMENT C – ACCLIMATIZATION

Acclimatization requires physical activity under heat stress conditions similar to those anticipated for the work being performed. A person is considered acclimatized if they have up to 3 consecutive work weeks of continued physical activity under heat-stress conditions and clothing similar to those anticipated for the work. Loss of acclimatization generally begins when the activity under those heat stress conditions is discontinued. A noticeable loss may occur after 4 days.

The acclimation status beyond the traditional work uniform (modesty clothing and a single pair of outer clothing), light work activities or use of impermeable clothing will require assistance from the organizational Industrial Hygiene representative and will be the responsibility of the Field Work Supervisor.

- Workers are assumed to be un-acclimatized until the proper level of heat stress exposure occurs to classify them as acclimatized.

- An employees' acclimatization status does not apply to work in impermeable or excessively heavy clothing, sudden heat waves, or work near radiant heat sources – consult IH for unusual conditions.

- While workers are acclimating, consider the following during the initial heat stress exposure:

  - Assign light workloads.
  - Allow longer rest periods.
  - Assign work in heat stress conditions for at least 2 hours/day.
  - Gradually increase the amount of time of work in the heat each day.
  - Observe workers' responses to the change in conditions.
  - The acclimatization process may be prolonged if work days are interspersed with days off or changes in shift; when levels of PPE vary on a daily basis; or, if exposure times vary considerably daily.