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Assistant Secretary of Labor for Occupational Safety and Health
U.S. Department of Labor

AIHA Comments on Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings, Advance Notice of Proposed Rulemaking
Docket No. OSHA-2021-0009 / RIN: 1218-AD39

Dear Assistant Secretary Parker:

The American Industrial Hygiene Association (AIHA), the association for scientists and professionals committed to preserving and ensuring occupational and environmental health and safety (OEHS), appreciates the opportunity to provide feedback on the Occupational Safety and Health Administration’s (OSHA) advance notice of proposed rulemaking (ANPRM) on heat injury and illness prevention in outdoor and indoor work settings. We hope you find our comments helpful and look forward to providing you with additional information. Please note that the header numbers correspond to the questions posed in the Federal Register notice.

General comments
AIHA believes that heat is a serious occupational hazard often not adequately controlled, thus a standard to provide employers and employees with guidance on acceptable exposures and controls is warranted. Such a standard should be based on site-specific criteria and provide enough flexibility in implementation that it does not block essential work from being done.

A standard based on some defined criteria, such as a set temperature in combination with relative humidity that can be measured with instruments such as a Wet Bulb Globe Temperature (WBGT), or a national source such as the National Weather Service local forecast, is most desirable. Once the criteria are set, additional actions can be taken to limit exposure to heat in the workplace. Thus, a national standard based on one or more of the existing standards is desirable. Whatever criteria are determined, they should be clear, such

that all employers can readily interpret and act on as needed. Large employers are more likely to have the capability to use instruments such as a WBGT and interpret the results, while small employers may not, particularly smaller employers who have a transient workforce.

A heat injury and illness prevention standard should also have some local decision-making component that provides flexibility to employers and employees. For example, outdoor construction work could incorporate shifts in work times to cooler portions of the day. Such administrative control measures could work in combination with other methods (e.g., break times and the availability of water and cooling locations).

An occupational heat injury and illness prevention standard should take into consideration differences in work locations, administrative variables such as solo workers, and employees who must continue to work regardless of ambient conditions (e.g., emergency responders, firefighters, health professionals, utility workers), and the impacts of personal protective equipment (PPE). Differences in PPE required for hazards and the potential for increased or reduced heat burdens should also be considered. For example, a steelworker working near hot ovens may be wearing a full-length reflective coat with a hardhat, respirator, safety goggles, and face shield, while a welder may be wearing a leather coat with heavy gloves, hardhat, respirator, and a welder’s helmet. Other examples include firefighters wearing their turnout gear during the summertime or fire-resistant clothing for close-proximity wildfire work.

Cold thermal stress
AIHA encourages OSHA to evaluate occupational cold stress hazards to determine whether a cold stress standard is warranted.

Heat stress – public health vs. occupational health and safety aspects
Overlaps between public health and occupational health and safety (OHS) perspectives, strategies, methods, and requirements should be considered. Heat stress management for workplaces typically has not considered non-occupational exposures. The increasing frequency and duration of extreme heat events will create more situations where entire populations may be subjected to severe thermal stress – effectively shifting the “wellness baseline” of workers who may also be exposed to thermal stress at work. As for some other agents, in particular wildfire smoke and infectious diseases like COVID-19, OHS requirements should align with and build on public health requirements and the promotion of self-protection off the job.

(4) Are there quantitative estimates of the magnitude of occupational illnesses, injuries, and fatalities related to hazardous heat, beyond what is described in this ANPRM?
When collecting and evaluating data to determine the effects of potential illness or injury on a worker population, the data collected is generally based on conditions and exposures at
the time of measurement, and any illnesses or injuries that had occurred due to that exposure are based on that time-defined set of data points. In evaluating worker exposure to heat stress, the same criteria apply. A complication of heat stress measurements is that they will have to be taken at different periods, and weather conditions can change very rapidly. For example, while climbing a ladder, a worker loses their grip and falls. Did they lose their grip because their hands were sweaty, or did they not grab the rail? Is the injury heat stress-related or a simple fall, and how should it be listed? As another example, a worker has a cardiac issue and suffers a stroke while working on a hot day – was it caused by the heat or the related work? The point is that it is difficult to classify many of these types of illnesses or injuries because the cause in many cases is compounded by underlying conditions. As a side note, especially when a transient workforce (e.g., construction workers) is present, an employer most often cannot inquire about nor would they be aware of an individuals' medical conditions unless the employee volunteered the information. Individuals with underlying conditions or addictions may be at higher risk for heat-related injuries (HRIs).

In summary, it is very difficult to obtain data related to heat stress injuries other than that which is obtained after the incident has occurred. Even then, underlying contributing factors may never be revealed.

(6) What factors lead to the underreporting of occupational heat-related illness, injuries, and fatalities of which OSHA should be aware?

It is important to define “underreporting” and to consider the context. “Under-recording” and “under-reporting” of injuries and illnesses in general is a chronic, systemic problem.²

Better questions might be “Is there less under-recording/underreporting in jurisdictions that have implemented heat stress standards?” and “Are HRIs more or less likely to be reported than other occupational illnesses?”³

Framing heat stress as a public health issue – increasing awareness and promoting (non-occupational) self-protection behaviors, as in the case of wildfire smoke or COVID-19, could encourage reporting.

Occupational illnesses in general are challenging to diagnose for several reasons: 1) similarities in the clinical presentation and pathophysiology of illnesses resulting from occupational and non-occupational exposures; 2) the latency period between exposure and symptom onset; 3) the multifactorial etiology of many diseases; and 4) if doctors do not inquire about work-related hazards, patients may not communicate such exposures (Taiwo et al. 2010). Further, there are many reasons why employees may not report illnesses or injuries to employers, including: 1) fear of discipline, termination, or being labeled as a

³ Related useful information can be found at [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4202759/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4202759)
problem employee; 2) economic incentives; and 3) foreign-born workers may fear being reported to the U.S. Citizenship and Immigration Services (AFL-CIO 2011). All of these factors, including lack of physician and patient awareness, may explain the underreporting and under-diagnosis of heat disorders, particularly in the working population.

Since heat exposure can contribute to accidents and cardiovascular or respiratory problems, estimates for worker HRIs are even more problematic, as it is difficult to recognize as a contributing factor to illness or death. Moreover, the criteria to define heat-related deaths may differ by State, and among physicians, medical examiners, and coroners (Donoghue et al. 1997). Even with a correct HRI diagnosis, the case may not be reported as work-related.

Each year, thousands of occupational heat-related illnesses are documented. During the last decade, more than 350 civilian workers died on the job due to environmental heat exposure (BLS 2013). These data may not include severe or fatal injuries or illnesses, such as falls or myocardial infarctions, for which heat was a contributory cause. In 1986, the National Institute for Occupational Safety and Health (NIOSH) estimated 5 to 10 million workers in the U.S. are exposed for at least part of the year to hot work conditions that can seriously threaten their health (NIOSH 1986).

(8) Are there industries, occupations, or job tasks that should be considered when evaluating the health and safety impacts of hazardous heat exposure in indoor and outdoor work environments? Please provide examples and data.

Instead of looking at specific industries or occupations, we recommend looking at the tasks and exposures, factoring in not only the ambient temperatures but also added heat sources. A road builder with exposure to hot asphalt or working on black pavement is at higher risk of heat stress (at the same ambient conditions) than a road builder working with concrete. Two painters working indoors may have the same air temperature in their building, however if one has added heat from a baking operation or a powder coating oven, that worker is at higher risk of overexposure.

The factors that lead to heat stress, in addition to the ambient temperature and humidity, include the work demands (someone sitting on a paver is at less risk than someone shoveling), the need for protective clothing such as welders’ leathers or firefighters’ uniforms, and whether the process itself generates heat. Considering those leads to a determination of the tasks or occupations with potential high exposure.

Heat-related deaths often occur in occupations in which workers are performing tasks in hot environments, causing them to build metabolic heat faster than their bodies can release heat and cool down.
(11) Addressing the full span of the hierarchy of controls, what are current and best practices for protecting workers in various types of work arrangements, including temporary and multi-employer work arrangements, from hazardous heat exposure?

Employers can reduce “workplace heat stress by implementing engineering and work practice controls.” Engineering controls may remove the heat source, shield workers from the heat, or increase the employee’s ability to cool their body (e.g., increased evaporation of sweat).

**Personal protective equipment**

Where appropriate, consider PPE that may help increase air circulation such as breathable fabrics, vented hardhats and eyewear, and respirators with the ability to provide air flow such as powered air purifying respirators or supplied air respirators with air temperature regulating valves.

(13) How are employers in businesses of various sizes currently preventing heat-related injury and illness in workers?

Employers can take many steps to prevent and reduce heat stress-related injuries and illnesses. These can include:

- Biomonitoring
- Cooling vests/bandanas
- Ensuring that contractors have heat stress prevention measures in place for their employees
- Ensuring that there are conditioned or shaded break areas with access to drinking water for employees and contractors and access to drinking water
- For fixed sites, setting up fans (or allowing/encouraging employees to bring their own)
- Heat shielding for stationary sources
- Job rotation
- Providing heat stress awareness training at the start of summer for all employees who may work in unconditioned environments

(14) Are there limitations or concerns in preventing heat-related injury and illness in workers that vary among businesses of various sizes?

While acclimatization is a key strategy for mitigating HRI’s, it is not always possible, particularly during intense heat waves of short duration. Expanding on this point, developing a work schedule that supports acclimatization is an effective control measure, but only applies if hot conditions are persistent. That does not happen throughout the upper half of the United States. For instance, in one 5-day period in August 2021, in Minneapolis-St. Paul,
Minnesota, the high temperatures were 90°F, 90°F, 75°F, 80°F, then 91°F. The highs for the period from July 4, 2021 to July 11, 2021, were 96°F, 82°F, 66°F, 73°F, 78°F, 81°F, and 87°F\(^5\). Temperature fluctuations such as those do not enable employers to use acclimatization schedules. That is not a function of company size – small or large companies cannot rely on steady weather conditions.

(15) How does geographic region contribute to occupational heat hazards and the outcomes experienced by workers? Please provide examples and data.

Regional differences in public risk perceptions should be considered when drafting requirements and when developing enforcement strategies, communications, and informational materials.

Public risk perception varies by geographic region\(^6\) and can be an important determinant of vulnerability to HRIs. For example, populations located in warmer climates have the highest risk perceptions. However, epidemiological research suggests that such populations do not necessarily experience the greatest health effects from extreme heat.

In addition, patterns in heat risk perceptions were associated with factors that predict social vulnerability to the hazard, including race, income, and gender. For example, areas with high minority and low-income populations perceive greater risks, while areas with older populations do not perceive greater risks, despite their increased vulnerability to the health effects of heat.

(18) What regional differences should be considered or accounted for when determining the appropriate interventions and practices to prevent heat-related injuries and illnesses among workers?

A standard that would require acclimatization as a major control method would be impossible to implement in areas with significant fluctuations in temperature (a high of 66°F one day, followed by a high of 86°F the next). However, acclimatization is an effective strategy when there are steady sources of heat, such as the ambient temperatures in the south in the summer or when there are manufacturer sources of heat, such as those in a laundry. In recognition of these realities, any standard should give employers the option of different approaches to control heat stress hazards.

\(^5\) [https://www.dnr.state.mn.us/climate/historical/daily-data.html?sid=mspthr&sname=Minneapolis/St%20Paul%20Threaded%20Record&sdate=2010-01-01&edate=por](https://www.dnr.state.mn.us/climate/historical/daily-data.html?sid=mspthr&sname=Minneapolis/St%20Paul%20Threaded%20Record&sdate=2010-01-01&edate=por)

\(^6\) [https://www.pnas.org/content/116/14/6743](https://www.pnas.org/content/116/14/6743)
(19) Are there specific populations facing disproportionate exposure to or outcomes from hazardous heat in indoor or outdoor work settings? Please provide examples and data.

Yes, besides migrant workers, there are a host of often low-paid and temporary or seasonal workers who work both indoors and outdoors without climate control. These workers may be employed in fishing, farming, ranching, construction, tanneries and textiles, surface mining, warehouses, laundries, food processing, restaurants, distribution centers and outdoor sporting events such as officiating baseball. However, indoor sports, such as volleyball and baseball, could be included if the heating, ventilating, and air conditioning systems are not operational during the season. Little exposure data is available to capture these occupations or industrial/environmental settings. Heat load indoors can vary based on occupancy, density, and duration of the exposure.

This question asks for information on “disproportionate exposure or outcomes”, “specific populations” and asks for “examples” and “data”. Currently, the term “disproportionate” is frequently used in discussions related to environmental justice and inequities. However, for the purposes of a regulation, and consistent with public health and OHS practice, the logical starting point would seem to be evaluating population exposures and vulnerabilities, then assessing whether these are due to inequities.7

For data and examples of how vulnerable populations in specific industries may be at greater risk of HRIs, please see

https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-021-12097-6

This University of Washington website describes research on the northwest forestry workforce, and would seem to be a good example of the complicated interplay between vulnerabilities and inequities in a workforce.8

With regard to HRI, the two most vulnerable worker subpopulations are workers greater than 45 years old and Latino immigrant workers, who are increasingly finding employment as laborers in the Pacific Northwest. For the latter, job-related injury and illness rates among these workers are two to three times the rates of the average U.S. worker, and fatality rates are 9 times as high.

In the case of Latino forest service workers, there are clearly inequities and environmental justice issues. However, this may also be the case for other forestry worker subpopulations.9,10

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7 The following paper is an example of “vulnerability mapping” at the population level – which identifies inequities in vulnerability related to population density, race and socio-economic status:
8 https://deohs.washington.edu/pnash/forest_safety
(20) Are there data sources available to assess inequalities in exposure to or outcomes from hazardous heat in indoor or outdoor work settings?
The factors that contribute to inequalities in exposure or outcome are complicated. There is a considerable body of literature dating back at least a decade exploring these factors, using methods such as “vulnerability mapping”, however standard methods have not yet been developed and validated.

The following are examples of data sources or studies related to vulnerability mapping:

- U.S. Climate Resilience Toolkit; Heat and Social Inequity in the United States
- Disproportionate exposure to urban heat island intensity across major US cities
  [https://www.nature.com/articles/s41467-021-22799-5](https://www.nature.com/articles/s41467-021-22799-5)
- Vulnerability to extreme heat and climate change: is ethnicity a factor?
  [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3728476/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3728476/)
- Identification of heat risk patterns in the U.S. National Capital Region by integrating heat stress and related vulnerability
- Mapping Heat Vulnerability in Michigan
- Mapping Heat Stress Vulnerability and Risk Assessment at the Neighborhood Scale to Drive Urban Adaptation Planning

(21) Are there industries or employers who are addressing occupational heat-related illness with an environmental justice approach (i.e., with a focus on fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income) to appropriately address the disproportionate exposures and outcomes faced by workers of color, low-wage workers, immigrant workers, or pregnant workers [NIOSH, April 20, 2017](https://www.cdc.gov/niosh/docs/2017/160/)? Please provide examples and data.

For some large employers, the answer is yes; however, for many small businesses, the answer is no. Small businesses may occupy rented or leased spaces that have no climate control, working under adverse conditions to get the job done. There are no other engineering controls to reduce the heat load or administrative controls to perform work during off-peak hours or take necessary rest periods to hydrate and rest. Many workers, such as roofers, can become somewhat acclimated to the hot environment except when transitioning into new jobs or performing work tasks that have higher heat stress and is especially true for new hires.

Almost all employers fail to realize the workers' medical condition related to heat stress. As an example, for workers who are carrying multiple panels of sheetrock up stairs on a
residential construction site, the additional heat load can put strain on the cardiovascular and pulmonary systems. Based on age and conditioning of the worker, this work and heat strain sometimes can lead to cardiac infarction and death. Other workers may work extended work shifts due to current labor market and demand for additional human talent to cover shifts and work operations.

Training and education are also limited, since some employers either fail to inform workers of the hazard and controls or use videotapes, web pages, or pamphlets to “check the box”, without any dialog or real understanding about heat stress, signs and symptoms of exposure, or controls that can be utilized in their particular work environment. Language and educational barriers may also be present, and training materials do not always address these challenges.

Environmental justice is most often discussed in the context of sustainability, particularly by larger firms and in specific industries, such as mining, that operate globally. In smaller firms and most industries, formal environmental justice initiatives, policies, and programs have not yet been implemented.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations was issued in 1994,11 the U.S. Environmental Protection Agency (EPA), U.S. Department of Health and Human Services, and U.S. DOL have published environmental justice plans or strategies since then,12,13,14 however, even the most recent strategic plan published by EPA15 does not speak to the need for individual companies to employ an environmental justice approach. In the absence of such guidance, regulatory requirements and economic or other business-related drivers, adoption of an environmental justice approach by businesses in general is unlikely.

However, many organizations have wellness or other employee health programs that include off-the-job safety and health and fitness for work. While such programs may not technically meet the definition of “environmental justice programs”, they may represent good faith efforts on the part of employers to address issues that are relevant to environmental justice, if only in a limited way.

Translating the concept of worker vulnerability into terms that are meaningful to employers, as in public health and OHS agency guidance on wildfire smoke exposures and COVID-19, might be an effective way to solicit information from employers and to communicate environmental justice concerns related to heat exposure inequities.

11 https://www.energy.gov/lm/services/environmental-justice/environmental-justice-history
12 https://www.energy.gov/lm/services/environmental-justice/environmental-justice-history
13 https://www.hhs.gov/sites/default/files/environmentaljustice/plan_at_glance.pdf
15 https://www.epa.gov/planandbudget/strategicplan
(27) Are OSHA’s existing efforts and authorities adequate or effective in protecting workers from hazardous heat in indoor and outdoor work settings?

A review of OSHA’s severe injury reports, 2015 through April 30, 2021, found 1,580 hospitalizations from heat stress, over 2% of all reported causes. Only 387 of those had associated inspections. Many of those had no citations. When OSHA did cite, it was usually under the General Duty Clause or under failure to report hospitalization (1904.39(a)(2)). Those statistics alone seem to indicate that OSHA does not have good measures to protect workers from heat.

OSHA, in the ANPRM, should provide an expanded table for clothing factors and levels of work detail (light, moderate, heavy, very heavy). There are wider varieties of clothing types and modern updates for work activity descriptions that affect the WBGT final calculations. These are applied to ACGIH Table 2 – Screening Criteria for TLV and Action Limit for Heat Stress Exposure.

(29) What are the gaps and limitations of existing applicable OSHA standards, as well as existing campaign, guidance, enforcement, and other efforts for preventing occupational heat-related illness in indoor and outdoor work settings?

Federal OSHA has no specific requirement for training employees on the hazards of heat or recognizing heat-related illness, other than the general training requirement in 1926.21, which is applicable only to construction.

(33) What components of a state standard or program should be included in Federal guidance or regulatory efforts on heat-related illness prevention?

Requirements in the Washington Labor and Industry 2008 WAC 296-62-095 and 2021 Emergency Rule\(^\text{16}\) that should be included in a Federal heat-related standard or guidance include:

- A requirement that employees be allowed and encouraged to take a preventive cool-down rest when they feel the need to do so to protect themselves from overheating
- A statement that employees are responsible for monitoring their own personal factors
- Clear requirements regarding extreme heat procedures, including cool-down rest periods and reduction of body temperature
- Clear requirements regarding relieving workers demonstrating HRI symptoms from duty and the monitoring of such employees to determine whether medical attention is required
- Clear requirements regarding the provision and consumption of drinking water and beverages containing electrolytes
- Conduct environmental and/or personal monitoring to measure working conditions and the heat load during work hours

• Define a hierarchy of controls that includes a combination of possible engineering, administrative, or PPE that can be used to reduce the risk of HRIs
• Define a scope and application of the standard for regulated industries under Federal OSHA including, but not limited to, general industry, construction, maritime industry, forestry and logging, and above-ground surface mining. It also should cover workers responding to both natural and human-made disasters
• Determine and enforce workplace limits of heat exposure for both indoor and outdoor activities with and without a solar load
• Document and maintain OSHA injury and illness records that reflect reports of heat-related illness
• Ensure competent person(s) monitor heat load and working conditions to make management changes to protect workers
• Establish requirements to construct a comprehensive program that includes, but not limited to, purpose and intent to protect the workforce
• Implement emergency response procedures for workers who are impacted by HRIs
• Implement medical surveillance program for those workers who are at high risk of exposure and those workers who may be compromised by certain medical conditions, illness or disease
• Inclusion of any outdoor heat exposure safety program in the employers’ accident prevention program
• Information and annual training – including supervisor training and a requirement for supervisors to follow defined procedures of an employee exhibits sign or symptoms consistent with possible HRI
• OSHA should issue one rule and issue separate guidance for outdoor vs. indoor heat exposures
• Periodically review the overall program administratively to identify any gaps or improvements
• Post warning signs for workers in known areas of hazardous work environments
• Seasonal application
• Surveillance should be repeated whenever there are changes in environmental conditions, workforce, production, duration of exposures, or work practices. Exposure should consider worker acclimatization or re-acclimatization where possible
• Train and educate the workforce to understand the employers’ heat stress policy, program and operating procedures, understanding the symptoms of exposure and the controls (including a work-rest regiment) to reduce the risk of exposure

Besides Washington State, California and Minnesota have heat stress plans for employers. The elements of the California program cover agriculture, construction, landscaping, oil and gas extraction, transportation, and delivery services. More information about the specific requirements of the California standard can be found at: https://www.dir.ca.gov/title8/3395.html

Minnesota administrative rules cover indoor thermal environments. Details of the administrative requirements can be found at: https://www.revisor.mn.gov/rules/5205.0110/
(34) Would any of the elements of the state standards not be feasible to include at the Federal level?

All of the requirements of the Washington Labor and Industry heat exposure rules should be feasible to include at the Federal level. Federal agencies (for example, the U.S. Department of Energy) have had programs that included similar and more stringent measures since at least the 1990s. Washington Labor and Industry’s experience shows that compliance with their requirements is not costly and can be achieved by all industries.

(41) What are the advantages and disadvantages of using each of these metrics (e.g., heat index, ambient temperature, WBGT) in indoor and outdoor work settings? Are there any challenges associated with training employers and employees on these different metrics?

Any metric that requires measures to be taken is problematic for the majority of employers and workplaces. Even for firms that have dedicated or designated OHS staff, purchasing equipment, training in equipment operation, assigning persons to take measurements, documenting, and communicating measurements can be difficult.

For most employers and workplaces, a simple index based on ambient temperature like the one in the Washington State rule – that facilitates go/no-go decisions is desirable. “In practice the WBGT is often seen to be excessively conservative and is largely ignored in many situations where rigorous implementation would lead to unacceptable and unnecessary losses in productivity.”

Similarly, where it is practicable to take measurements, a simplified decision logic is desirable.

The Thermal Work Limit (TWL) index developed in Australia and used in the Australian mining industry requires measurements, but uses 4 go/no-go categories.

The Thermal Work Limit Is a Simple Reliable Heat Index for the Protection of Workers in Thermally Stressful Environments.

Limitations of Heat Index measurements include lack of consideration for radiant heat load, and impact of layers of clothing or PPE such as protective coveralls.

(59) What engineering controls, administrative controls, or PPE can be used to prevent heat-related illness in indoor and outdoor work settings? Have the qualitative or quantitative effectiveness of these controls been evaluated?

Several types of PPE have been researched to help reduce a workers’ heat load, including cooling vests which pump cool water or air through the vest. Other types of PPE that have

been evaluated include ice vests, gel pack vests, etc. If respirators are required, consider a variety of options. For example, cooling vortex tubes may be available as part of supplied air respiratory systems. Vortex tubes may be able to cool breathing air by up to 50°F (28°C). Consider reducing the number of layers of clothing a worker may need to wear by incorporating breathable high visibility materials into the primary layer of clothing, such as a T-shirt, instead of wearing an additional vest. Consider PPE, which allows more air circulation, such as vented hard hats.

(62) What are the limitations associated with implementing water, rest, and shade effectively in indoor and outdoor work settings?
Situations where work – often critical work – must be performed by one or more specific employees at a specific location and within a specific period of time may allow for less or limited flexibility.

Examples of other practical factors that may complicate the provision of water, rest and shade include rest locations being at a distance from work locations, workers using specific equipment (e.g., manlifts), work locations that require special access (e.g., roofs), use of protective clothing or PPE that may be contaminated.

Industries in which heat stress is a known issue and standard work planning routinely incorporates heat exposure prevention measures (e.g., nuclear, electrical) will be more able to comply with any regulations or guidance. Other industries, particularly those dominated by smaller employers, may have more difficulty adapting to new requirements, at least initially.

(73) Are there industries or individual employers implementing exposure, medical, and/or physiological monitoring to assess workers’ health and safety during hazardous heat events?
The heat stress monitoring measures implemented by Washington River Protection Solutions at the U.S. Department of Energy Hanford site is of interest because of the simplicity, where monitoring was used for specific types of work in combination with traditional heat stress measures implemented using thresholds based on ambient temperature. Similar programs in which workers could measure heart rate with either dedicated devices or smartphones could offer an added layer of protection in many industries, particularly for vulnerable individuals.

19 https://www.cdc.gov/niosh/research-rounds/resroundsv2n12.html
20 https://digitalcommons.usf.edu/cgi/viewcontent.cgi?article=5711&context=etd
(80) How do you use physiological monitoring data (e.g., as a short term response to heat stress conditions, to address long term examination in protecting employees, to identify high risk categories of workers)?

Short-term monitoring in places such as foundries can be invaluable. Tracking the WBGT upwards of 48°C and Watts/seconds (570 J) can reveal trends under predicted high heat stress.

Options include:
- Core body temp
- Inexpensive wearables, such as watches
- Monitoring heart rate and recovery time from baseline
- Temporal thermal scanners (skin temperature)
- Water loss (weighing)

(83) Are there unique concerns or approaches in developing a monitoring program for small versus large businesses?

Monitoring in small businesses will be a challenge. The approaches used for them must be simple, easily understood, and easily performed. Even using a sling psychrometer could be a challenge. While temperature checks could be feasible as a way to identify immediate problems, any medical or physiological monitoring beyond that would require resources they lack. For companies too small to have health and safety personnel, environmental monitoring must be very simple if it is to be effective.

(87) What should be included in an employer’s heat emergency response plan?

The emergency response plan should consider the capability and capacity to deliver medical assistance quickly. In some instances, personnel onsite may need to be able to respond to medical emergencies utilizing their First-Aid and CPR training and education. Relying on the Emergency Management System (EMS) to respond may jeopardize a worker’s health and wellbeing.

(89) When should employers refer employees for medical treatment or seek medical treatment for an employee who is experiencing a heat-illness emergency?

Prevention is key, since some health effects can be sudden and catastrophic (such as the case of heat stroke). Nobody should wait to receive medical treatment when experiencing the symptoms of exposure. If trained EMS personnel are onsite and available for consultation, these resources should be utilized whenever possible.

Workers should be adequately trained to understand the hazard and risks. Workers should understand the controls needed to protect themselves from heat-related illness. If working conditions change so should the hierarchy of controls. Constant communication with the workforce on their health and wellbeing, along with vigilant monitoring of environmental
and physiological working conditions, should be paramount. Workers with confounding factors that elevate their level of risk should speak with the employer. Additional controls may be necessary to protect these workers' health and livelihood.

(91) How do employers currently involve workers in heat injury and illness prevention?  
Involvement often includes communication for self and supervisory monitoring and education, reminding employees when they are at risk for closer supervision, and self-awareness.

(92) What types of occupational heat injury and illness prevention training programs have been implemented and how effective are they? What is the scope and format of these training programs? Are workers in non-traditional/multi-employer work arrangements included in these training programs?  
Alchemy Training Systems addresses heat stress during orientation/onboarding. This lesson is also part of the annual refresher, and continued conversations occur between supervisors and staff to increase heat hazard awareness.

Other examples:
- National Institutes of Health Heat Stress Program Division of Occupational Health & Safety May 2013 provides an outline for a heat stress training program
- NIOSH Criteria for Recommended Standard on Occupational Exposure to Heat and Hot Environments Revised Criteria 2016

(93) What are best practices in worker training and engagement in heat injury and illness prevention?  
Best practices include worker training, communication, awareness of the conditions that trigger the implementation of additional steps for the prevention of HRIIs, and ensuring that decision-making is more objective, based on the risk factors involved.

Training must cover both the hazards of heat (the symptoms) and the measures employees need to take. That is not to suggest that the responsibility for the prevention of heat stress is solely based on employee actions. However, the employee will usually be the first to notice they are experiencing symptoms of heat stress. Knowing that the employer expects the employee to take action at that time (e.g., take a break) will encourage employees to do just that, instead of working through the discomfort.

(94) How do employers involve workers in the design and implementation of heat injury and illness prevention activities?
Engineering controls include shadowing (natural) and air conditioning/cooling (artificial). Heat generation from product production and processing contribute, but those areas would have limited exposure.

(95) What challenges are there with worker training and engagement for heat injury and illness prevention?
Employee risk perceptions based on cost risk are among the greatest challenges. Sometimes, employees may not be willing to participate in risk mitigation practices based on their risk perceptions.

(96) OSHA requests any workers' compensation data related to heat-related injury and illness. Any other information on your workplace's experience would also be appreciated.
One small manufacturer (40 employees) of steel equipment had three reports of heat exhaustion in the painting department on one August day, when the outside high for the day was 94°F. The employees’ tasks included spray painting (using half mask respirators) and moving parts. Employee ages ranged from 30 to 55. First Reports of Injury were filed for all three painters; all received medical care, but none received care beyond first aid treatment. All lost some time from work that day, but none lost time beyond that day. These were not OSHA-recordable injuries, and the workers’ compensation costs were minimal. But there were costs for lost productivity.

(99) If you utilize the WBGT method when making your work determinations, what were the costs of any associated equipment and/or training to implement this measurement method?
The WBGT tool was $250. Training was already built into the orientation/onboarding process. Other instruments can be found online for about $150 without training. Below are some important considerations when choosing to purchase or rent a WBGT instrument.

Calibration and maintenance are important and can be an additional expense for a capital purchase. In some cases, it may be better to rent the instrument from a reputable vendor who maintains and calibrates the instrument regularly. The decision to rent or purchase depends on the extent of use. If the instrument will be used regularly, the cost of purchasing and sending it out for maintenance and calibration may be the best option. If the instrument is only used periodically, it may be better to rent it rather than assume the cost for purchase, calibration, and maintenance.
(100) If you utilize a temperature metric other than WBGT when making work determinations, what were the costs associated with measurement and/or training to implement this measurement method?
Using the Heat Index app is free and available with internet access. Even if you can’t get a signal at a specific location, if you know the projected high temp and humidity you can use the app to see what the risk will be later on when offline.

(101) Have you instituted programs or policies directed at mitigating heat-related injury and illness at your worksite? If so, what were the resulting benefits?
An emphasis on supervisory monitoring, employee involvement, and communication was added. The resulting benefits were difficult to quantify, however from a qualitative perspective, the benefits outweighed the costs.

(102) If you have implemented a heat injury and illness program or policy, what was the cost of implementing the program or policy, in terms of both time and expenditures for supplies and equipment? Please describe in detail the resource requirements and associated costs expended to initiate the program(s) and to conduct the program(s) annually. If you have any other estimates of the costs of preventing or mitigating heat-related injury and illness, please provide them. It would be helpful to OSHA to learn both overall totals and specific components of the program (e.g., cost of equipment, equipment installation, equipment maintenance, training programs, staff time, facility redesign).

d. Has your program reduced indirect costs for your facility (e.g., reductions in absenteeism and worker turnover; increases in reported productivity, satisfaction, and level of safety in the workplace)?
The biggest cost associated with this was adding an air conditioning system. Maintenance installation had no impact or effect on production. The direct cost of installation for the air conditioning system was approximately $10,000.
- Cleaning the room
- Commercial chemical environment rated A.C. A.C. Unit
- Costs to design/reengineer a space
- Curtains
- Labor to gut the room of old equipment
- Providing new 240V. electrical disconnect

(103) Do you provide wearable devices (specific to heat) to workers? Does each worker get a device or only specific members of the crew?
Limitations must be considered when providing wearables. First, any personal monitoring device needs to accommodate the need of the individual wearer and measure aspects that
can help assess heat strain on the body. The accuracy of measurements of core temperature from external devices may vary depending on the location of the device, and as such, caution should be used with the data. Watches, other strap-on, or external devices are improving in their ability measure aspects such as heart rate, and oxygen levels via pulse oximeters, and may help provide good information which may be helpful as part of a heat management program; however, caution should be used in relying on this alone. The collection of what could be considered medical data will also need to be addressed.

(104) If you are in a state with standards requiring programs and/or policies to reduce heat stress, how did implementing the program and/or policy affect the facility's budget and finances?

Minnesota does not have a standardized program, rather, the State has defined a set of protocols to follow, Appendix A5205.0110 SubPart 2A based on WBGT and level of work activity. There was no significant impact on the implementation of the program. The WBGT was $250, urinalysis chart, hydration level, and personnel appearance. Much of the cost was in the form of supervisor expectation and deemed insignificant. Another cost was more frequent breaks, albeit production was not stopped, which was also considered insignificant. A room was modified to be cooler with an air conditioner for $10,000 in direct costs with no impact to production from maintenance installation.

(107) How does your workplace address the costs of any rest breaks necessary to prevent heat-related injury and illness?

The costs were insignificant since extra break time was implemented without affecting production or operations. Breaks generally have more positives than negatives when managed properly.

Breaks for hydration are concurrent with shade, and breaks in areas with air conditioning help reduce the risks of heat illness.

(109) How, and to what extent, would small entities in your industry be affected by a potential OSHA standard to prevent heat stress? Do special circumstances exist that make preventing heat stress more difficult or more costly for small entities than for large entities? Please describe these circumstances.

Any safety and health program presents upfront costs that are more difficult for small companies to bear. If employees are currently trained on chemical hazards (as should be done under the Hazard Communication Standard), the cost of additional training on heat exposures can be insignificant, because it can be wrapped into the same training sessions. If a heat standard requires the installation of engineering controls such as air conditioning, upfront costs would be substantial, but may be offset by gains in productivity. Those gains won’t be immediately apparent to the small business owner.
If a heat standard requires an increased number and extent of breaks, there may be a perception that the standard is costing productivity. That could be a concern for both employers and, for jobs that pay based on productivity, for the workers. It could also cause staffing problems.

The primary counter to the arguments about lost productivity is that heat is tiring. Employees are likely to be more productive if they are not overheating.

(110) How many, and in what type of small entities, is heat-related injury and illness a threat, and what percentage of their industry (by NAICS codes) do these entities comprise?

Heat-related illness is a concern in any general industry operations that generate heat or steam as an inherent part of the process. Small laundries and dry cleaners (NAICS 81232) have significant heat exposure. Restaurant kitchens, including dishwashing operations, will have heat exposures. If the facility is not air-conditioned, as may be the case in small laundries, employees’ exposure to heat is a combination of the ambient effective temperature plus the process effective temperature.

HRIs are also a concern for outdoor workers. For instance, employees working with hot asphalt (paving, patching) are exposed to both ambient heat plus the process heat. Employees working on dark roadways (typically asphalt roads) are exposed to radiant heat from the road.

Heat stress is a growing concern in many different occupational settings as it endangers worker health, safety, and productivity. While construction, above-ground mining, maritime operations, electrical utility workers, landscapers, oil and gas extraction, and other outdoor work is a concern for both large and small employers, there are many small farms, ranches, agricultural and other settings where heat stress is a concern across America. Heat stress can also impact sporting events, both on a local and national level. Additionally, there is an informal economy of day laborers that work in these workplaces.

While some may consider heat stress a domestic issue, the adverse effects of heat on workers' health and work productivity are well documented globally. The resultant economic consequences, productivity loss, and impact on the global supply chain are less understood. Some studies aimed to summarize the retrospective and potential future economic burden of workplace heat exposure in the context of climate change.

The estimated global economic burden of occupational heat stress is substantial. Climate change adaptation and mitigation strategies should be implemented to likely minimize future costs. Further research should explore the relationship between occupational heat stress and related expenses from lost productivity, decreased work efficiency and healthcare, and costs stratified by demographic factors is warranted. The key message is the estimated retrospective and future economic burden from occupational heat stress is large. Responding to climate change and protecting the workforce is crucial to minimize this
burden. Analyzing heat-attributable occupational costs may guide the development of workplace heat management policies and practices as part of global warming strategies.

(111) Are there alternative regulatory or non-regulatory approaches OSHA could use to mitigate possible impacts on small entities?
There are many industrial, manufacturing and trade associations that can help small to large employers. Just in the agricultural business alone, there are 439 trade associations. Combined with the vast resources from federal OSHA and State consultation programs and human talent from university programs, there is a wealth of resources to help employers construct a model occupational heat and hot environment health and safety plan.

Additionally, AIHA, ASSP, Workplace Health Without Borders – U.S. Branch, and many other loss control representatives from major workers’ compensation insurers along with the dedicated industrial hygiene and occupational health and safety professionals and consultants can provide the resources and human talent to support this endeavor. Help is available if the employer wants to protect the workforce from heat stress.

(112) For very small entities (historically defined by OSHA as those with fewer than 20 employees), what types of heat-related injury and illness threats are faced by workers? Does your experience with heat-related injury and illness reflect the lower rates reported by BLS?
Heat exhaustion is most common, which may go unreported. Heat stroke is most severe, but likely only contributes to 10% of cases. Supervision and management malpractice would be the most likely cause of a heat stress injury or illness because they would not be monitoring their employees as they should be.

We know from conversations with workers of occurrences of heat rash and heat exhaustion in very small businesses. Those have not been reported as work-related injuries (no First Reports of Injury were filed). Employees (and possibly their employers) have not recognized HRLs as occupational injuries. Often, because they are not traumatic injuries, they are perceived as being different.

(113) For very small entities, what are the unique challenges establishments face in addressing heat-related injury and illness?
Lack of staffing, lack of education, and lack of availability of resources. There is a two-way street between employer and employee. Both must be aware of the environment and conditions, and employees must be willing to participate. Employees must be willing to speak up when they need a break. Programs should be built upon a conditioned break schedule based on a heat tolerance scale determined by the WBGT at the time.

Very small entities need programs that are simple to administer and simple to understand; they also need outreach. Based on one consultants’ 30 years of experience working with
small businesses (typically under 40 employees; usually under 20), the companies believe they offer safe workplaces – but they do not know what they don’t know, and the people responsible for safety oversight also are responsible for production, ordering, scheduling, and customer relations. As such, they will be challenged to find the time to develop and implement a new program. And, unless they have experienced adverse heat events personally, they may not be convinced of the need.

The publicity around new standards provides a strong incentive to adopt more protective practices. However, the standard has to be something they can implement without stretching their financial or time budgets beyond repair. A standard that, for example, allows business owners to use readily available information such as National Weather Service warnings will be easier for them to comply with than one that would require monitoring in each facility.

The most critical elements of a program or policy to protect employees from heat stress seem to be training, providing fluids and breaks, and paying attention to employees’ conditions (not necessarily physiological monitoring, but practices such as buddy systems). Buddy system monitoring (as long as workers aren’t working alone) and providing fluids are not difficult to implement. Training and more frequent breaks may be more challenging.

Small businesses won’t have people available for in-house for training. They will need to rely on consultants or canned programs. Engineering controls should also be encouraged, particularly as they can reduce the need for breaks and the costs of reduced productivity, however, they may not always be feasible for very small businesses. Administrative controls, such as scheduling work for cooler times, will often be feasible and are another type of control that should be encouraged.

**Conclusion and Next Steps**

AIHA thanks you for the opportunity to provide feedback on this ANPRM and looks forward to working with OSHA to help protect all workers from occupational injuries and illnesses. If you have any questions on these comments or other matters, please contact Mark Ames at mames@aiha.org or (703) 846-0730.

Sincerely,

Lawrence Sloan, MBA, FASAE, CAE
Chief Executive Officer
AIHA

**About AIHA**

AIHA is the association for scientists and professionals committed to preserving and ensuring occupational and environmental health and safety in the workplace and
community. Founded in 1939, we support our members with our expertise, networks, comprehensive education programs, and other products and services that help them maintain the highest professional and competency standards. More than half of AIHA’s nearly 8,500 members are Certified Industrial Hygienists and many hold other professional designations. AIHA serves as a resource for those employed across the public and private sectors as well as to the communities in which they work. For more information, please visit www.aiha.org.