

1. OBJECTIVE

The purpose of this HSE Instruction is to provide Technical Guidance Note on Industrial Best Practice for QAPCO Employees & contractors in order to enable them to manage occupational health hazards associated with Heat Exposure. Heat stress management instructions are aimed to prevent, manage and treat heat related illnesses arising due to extreme temperatures during summer season.

2. SCOPE

This HSE Instruction shall apply to all QAPCO premises & any future expansions within QAPCO, which require individuals to work outdoors in a hot climate or near to the sources of radiant heat. i.e. turbines, compressors, boilers, furnaces etc. Emergency Response Activities and other safety/integrity critical task activities are excluded from the general requirements of this Instructions. However, some additional control measures (i.e. modified work- rest cycles, Rehydration frequencies) needs to follow during these activities.

By following this HSE instruction, QAPCO will demonstrate that it has applied good occupational health work practices to tackle heat stress hazards at site. However, QAPCO and contractors are free to take an alternative/additional control strategies as Industrial Best Practices; provided that they meet requirements stipulated in this Instruction as a minimum.

3. INSTRUCTION SUMMARY

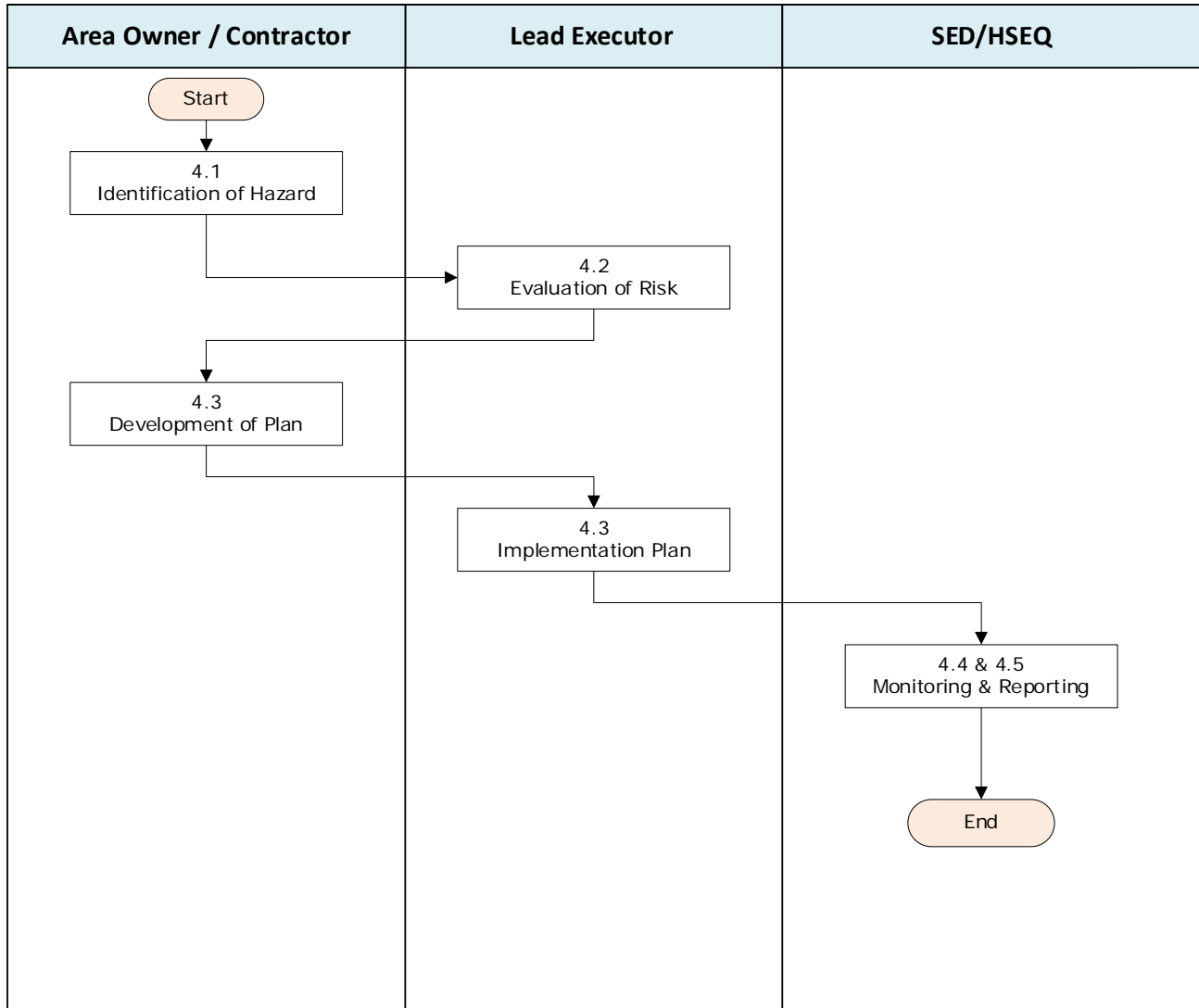
This HSE instruction (to be referred as technical guidance note) addresses all major aspects associated with Heat Stress Management, such as 1) Scientific definitions and explanation of technical terms 2) Legal and social responsibilities 3) Identification, measurement and evaluation of heat stress 4) Environmental factors contributing to heat stress 5) Control strategies and routine monitoring of implementation.

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4. HEAT-STRESS MANAGEMENT PROCESS WORKFLOW

Heat Stress Management is a multifaceted program to Identify, Evaluate and Control the Health Risks associated with Heat-stress and other heat related illnesses.



HEAT-STRESS MANAGEMENT CLARIFICATIONS**Clarifications details****4.1 IDENTIFICATION OF HAZARDS & LOSS EXPOSURES:**

Identifying High Risk Zone for Heat Stress Hazards will be obviously based on the ambient weather condition and type of activities to be performed. By considering weather conditions of QATAR, summer months are evidently in High Risk Zone as a result of increased ambient temperature and humidity levels.

As a General guideline, following Conditions or Activities should be considered as 'High Risk' Category (Danger Zone) for Heat Stress:

- Any Outdoor Work Activities during Summer Months (From May to October) – which are performed under direct sun-light. Where Heat Index is in "Danger Zone", i.e. HI >39.
- Heavy Physical Demand Work on or near to "Radiant Heat Sources" such as Boilers, Compressors, Furnaces, Turbines and Heat-Exchangers where HI is high.

While evaluating working conditions, following points to be considered:

4.1.1 Factors Contributing to Heat Stress: Heat stress is normally brought about by a range or combination of factors involving the interaction of the Activity/Task, environment and the employee.

- Activities/Task Factors:
 - Frequency of exposure
 - Duration of exposure
 - Physicality of work, i.e. Light, Medium, Heavy Work
 - Inadequate rest periods
- Environmental Factors:
 - High air temperatures
 - Low air movement
 - High relative humidity
 - Radiant heat from hot objects such as machinery
- Employee Factors:
 - Incomplete acclimatization
 - Dehydration
 - Excessive or inappropriate clothing
 - Individual susceptibility (age, obesity, physical condition, Ramadan fasting, etc.)

4.2 EVALUATION OF THE RISKS OF "HEAT-STRESS":

For people working outdoors in hot weather, both air temperature and humidity affect how hot they feel. The "Heat Index (HI)" is a single value that takes both temperature and humidity into account. The higher the heat index, the hotter the weather feels, since sweat does not readily evaporate and cool the skin. The heat index is a better measure than air temperature alone for estimating the risk to workers from environmental heat sources.

4.2.1 Heat Index Calculations: The Heat Index is calculated using a formula which incorporates air temperature and relative humidity.

$$HI = -42.379 + 2.04901523 \times T + 10.14333127 \times RH - (0.22475541 \times T \times RH) - (0.00683783 \times T^2) - (0.05481717 \times RH^2) + (0.00122874 \times T^2 \times RH) + (8.5282 \times 10^{-4} \times T \times RH^2) - (1.99 \times 10^{-6} \times T^2 RH^2)$$

- Where T = Temperature in degrees F and RH is relative humidity in percent. HI is the heat index expressed as an apparent temperature in degrees F.
- if the RH is greater than 85% and the temperature is between 80 and 87 degrees F, then the following adjustment is added to HI: ADJUSTMENT = [(RH-85)/10] * [(87-T)/5]

4.2.2 Heat Index Risk Rating: Heat Stress Severity is classified according to the numeric value of Heat Index. HI- 27 to 54 is segregated in 4 severity zones, such as: 1) Caution 2) Extreme Caution 3) Danger 4) Extreme Danger.

Heat Index Chart and Risk Categorization is shown in figure-2:

HOW TO CALCULATE HEAT INDEX

		RELATIVE HUMIDITY (RH)								
		10%	20%	30%	40%	50%	60%	70%	80%	90%
AIR TEMPERATURE (°C)	50	44	52	54	>54	>54	>54	>54	>54	>54
	49	43	51	54	>54	>54	>54	>54	>54	>54
	48	43	50	53	54	>54	>54	>54	>54	>54
	47	42	48	52	54	>54	>54	>54	>54	>54
	46	41	47	50	54	>54	>54	>54	>54	>54
	45	41	46	50	54	>54	>54	>54	>54	>54
	44	40	45	49	54	>54	>54	>54	>54	>54
	43	39	44	48	54	>54	>54	>54	>54	>54
	42	38	43	46	54	>54	>54	>54	>54	>54
	41	38	41	45	52	54	>54	>54	>54	>54
	40	37	40	43	49	54	>54	>54	>54	>54
	39	36	38	42	47	52	54	>54	>54	>54
	38	35	37	41	43	49	54	>54	>54	>54
	37	34	36	38	41	43	54	54	>54	>54
	36	33	35	37	40	42	49	53	54	>54
	35	32	34	36	39	42	46	52	54	>54
	34	32	34	35	38	41	44	50	53	54
	33	31	32	33	36	38	41	46	50	53
	32	29	31	32	33	36	38	41	46	50
31	28	30	31	32	34	35	38	41	46	
30	27	29	29	31	32	33	36	38	43	
29	26	27	28	29	30	32	33	35	37	
28	25	26	27	27	29	30	32	33	35	
27	24	25	26	26	27	28	29	30	32	
26	22	24	25	26	26	27	27	28	29	

Example : The temperature stands at 34°C and RH is now 62%. The Heat Index is 44 in the Danger Area.

SEVERITY	HEAT INDEX	HEAT SYNDROME
IV. Extreme Danger	> 54	Heat Stroke or Sunstroke imminent
III. Danger	39 - 53	Sunstroke, Heat Cramps or Heat Exhaustion likely, Heat Stroke possible with prolonged exposure and physical activity
II. Extreme Caution	32 - 38	Sunstroke, Heat Cramps or Heat Exhaustion possible with prolonged exposure and physical activity
I. Caution	27 - 31	Fatigue possible with prolonged exposure and physical activity

*Note : 1. Degree of Heat Stress may vary with age, health and body characteristics.
2. Do not take any form of "Salt Supplement" unless advised.

Heat Index Card & Risk Categorization

4.3 DEVELOPMENT OF PLAN AND ITS IMPLEMENTATION:

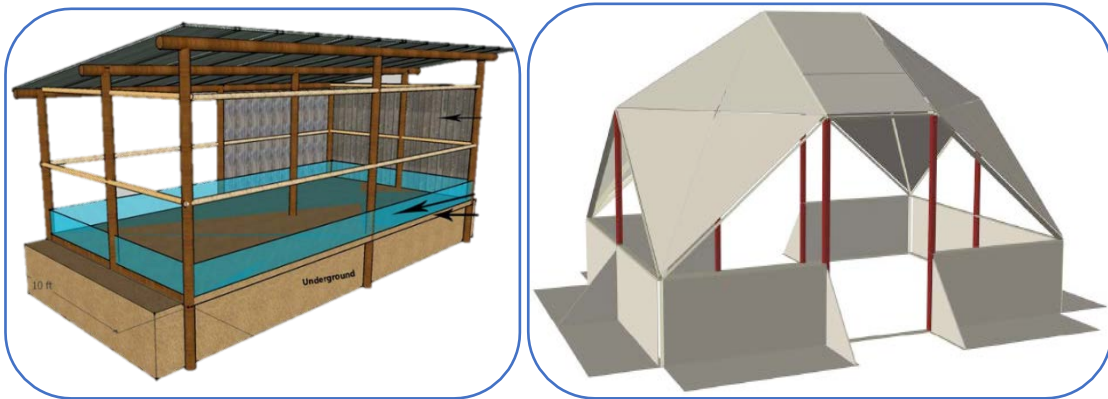
After identification and evaluation of Risk Zone, most important part is to prevent or mitigate the Risk by various control strategies. Hierarchy of Risk Control Techniques should be as follows:

- 1) Elimination & Substitution
- 2) Engineering Controls
- 3) Administrative Controls and
- 4) PPE.

4.3.1 Elimination & Substitution of Heat Stress Hazards: Turn-Around and major project/modifications activities (involves heavy physical work activities) should not be planned during summer months (May to September) as far as it is reasonably & economically practicable.

4.3.2 Engineering Control Measures: There are various types of engineering solutions possible in order to prevent or control the health risks associated with heat exposure. Best possible engineering solutions are mentioned below:

- A. Shelters & Ventilated Rest Areas:** QAPCO as well as contractors shall provide sufficient numbers of shadow shelters. Contractors working inside QAPCO Premises must have to build a Rest shelter as per specification given below. Shadow shelters and rest areas should be equipped with cool drinking water and proper ventilation.



Heat-stress Rest Shelters Design.

However, the thermal comfort levels, recovery periods, provision of drinking water, availability of electrolyte etc. should also be given equal importance. Each Rest Shelters should have following minimum requirements:

1. Resting Benches/chairs- (Seating Arrangements)
2. Cross Ventilation and sufficient air supply either by natural ventilation or by means of Fans or AC Units. If Rest-Shelter is of Tent type, then AC Units are mandatory to keep inside tent.
3. To facilitate natural cross ventilation, each rest shelter must have at-least 8-10 inch openings at bottom and top of shelter. Remaining areas must be covered by Green Mesh (or equivalent material) which partially permit air passage.
4. Shelter roof should be corrugated Sandwich roof or similar type which prevents direct sunlight and radiant heat.
5. Cool Drinking Water Dispenser with proper drain.

Secondary Measures (Optional) as an Industrial Best Practices:

- Drinking water Supplements-Optional (i.e. ORS)
- First-aid box (For contractors' shelter)
- Air-Conditioned Caravans- Portable type
- Portable Trailer mounted air conditioning units to be utilized for larger enclosed areas or confined spaces or vessel.
- Cloth Dryer or provision of additional coverall (work uniform)

- B. Thermal Insulation:** All the radiant heat sources and their supply/outlet lines should be thermally insulated in order to reduce overall heat load transmitted to surrounding atmosphere. Steam lines &

its Release points are also to be designed in such a way that it doesn't increase surrounding climate temperature.

4.3.3 Administrative Control Measures: Administrative controls attempt to minimize risks through work practices. They are relatively easy to implement, although they may not be the most cost effective. Administrative controls include the following:

A. Heat Index Measurements & controls: QAPCO has implemented real-time (Live) Heat-Index Monitoring system called SMART Heat-Stress Management System. This 'SMART' HSM system includes following major components:

- Real Time "Heat Index" Measuring Stations (Sensing & Display Stations)]
- LED Display Screens/panels to show Live "Heat Index Value"
- Heat Index Data Management, Evaluation & Analysis Platform
- Web portal, IT Integration and Mobile Applications.



Official report displayed at QAPCO portal indicating the heat index, temperature and humidity are available for all employees. QAPCO Fire station also announces Heat Index on daily basis (regular interval) throughout the summer months. According to the heat stress index, immediate actions can be taken as per control interventions mentioned in the heat index card. (see table below, for more details)

Table-1: Preventive Heat Stress Practices to Minimize the Effect of Heat Exposure

HEAT INDEX (Flag/light Colour)	WORK : REST PERIOD (Minutes)	WATER REQUIREMENTS (1 Cup = 250 ml)	CONTROLS
27 - 31	50 : 10	1 cup every 20 minutes	Continuous Visual Monitoring of Workers in Direct sun and Heavy work
32 - 38	40 : 10	1 cup every 20 minutes	No Working Alone
39 - 49	30 : 10	1 cup every 15 minutes	Work Under shade preferred
50 - 53	20 : 10	1 cup every 10 minutes	Stop all Elevated Works
≥ 54	----	----	Stop All Activities Only Critical Activities* can continue

* Critical activities = Essential, not reschedulable, uninterruptable, critical path and if incomplete could lead to dangerous situation, or impact material or plant integrity.

Additional Control Strategies for Work Activities at Heat index ≥ 54 :

When Heat-Index Reaches 54 and above only critical activities* can continue

- › When in an area Heat index ≥ 54 there will be a specific announcement to all staff.
- › All works in that area should be discussed and evaluated by production/safety and the Job executor.
- › Only critical activities may continue with additional controls:
 - 1) Modified or adjusted Work-Rest Cycles to be decided in JSA.
 - 2) Provision of Area cooling & portable fans etc.... if applicable.
 - 3) Use of Specialized PPE, such as Cooling Vest, Head & Neck shade etc.



Special PPE:

- Cooling Vest
- Head & Neck cool shade

Available at QAPCO Firefighting Store

Use:

To achieve the best performance and comfort the Cooling Vest should be worn **above** a thin garment, preferably a functional shirt, that transports humidity. Cooling Vest should be worn **tight to the body**. This is important taking on account its function and comfort.

Make sure you have the correct size. Use the velcros to tighten the vest properly.

If Heat Index ≥ 54 : All employees and contractors on-site will be notified via red-light flashing and digital display on heat-index stations, a fire fighting announcement by public address and radio safety channel and e-mail notification on High Heat Index Alert.



July and August are generally the hottest months of summer in QATAR, so 'Plan & Prioritize' all the job well in advance and avoid exposing employees during peak temperature hours or minimize exposure duration.

- B. Buddy System:** When working on high temperature tasks, consideration should be given to working in pairs, with each person watching out for early warning signs of excessive heat stress in the other person. In high temperature confined spaces, Hole-watcher (the man who watch the activity) should be aware of the warning signs of excessive heat stress and should ensure safe entry conditions, i.e. Work & Rest Schedule, Hydration Levels etc.
- C. Fluid Replacement:** One of the most important means of reducing the risk of heat stress is drinking plenty of fluids (cool water). When doing hard work in hot areas dehydration may occur due to heavy

sweating before a person even feels thirsty. It is recommended that at least half liter of water be consumed every 20 minutes to prevent dehydration and reduce the risk of illness. Refer to the dehydration guide utilizing urine color chart in Appenidx-2. Cool water should be readily available during hot weather or in hot work areas. Salt tablets are not recommended. A well-balanced diet should replace all necessary salts and electrolytes.

- D. Work Scheduling:** Scheduling heavy physical demand jobs in a cooler part of day can significantly reduce the risk of heat stress. Major maintenance jobs or Plant shutdown activities (Planned) shall be scheduled before or after peak hours. (11 am to 3.30 pm) of the summer season. However emergency activities or unplanned events can be conducted anytime by following proper risk control techniques.
- E. Work / rest regime:** The ratio of working time / rest periods (work/rest regime) depends on the actual Situation measured with the QAPCO heat index (displayed at the portal) and announced by the public address system. The heat stress index card including the work/rest regime shall be distributed to all QAPCO employees and also displayed on site.
- F. Acclimatization:** A properly designed and applied acclimatization program decreases the risk of heat-related illnesses. Such program basically involves exposing employees to work in a hot environment for progressively longer periods. Supervisors and foremen shall be instructed about the acclimatization period and the work/rest regime for newcomers. HSE personnel shall monitor the implementation and remind supervisors and workers to strictly follow the acclimatization periods. The work/rest regime for acclimatization shall be as follows:

NIOSH Acclimatization Recommendations for New Workers		NIOSH Acclimatization Recommendations for Workers with Previous Experience* with the Same Job	
1st day	20% usual work duration	1st day	50% usual work duration
2nd day	40% usual work duration	2nd day	60% usual work duration
3rd day	60% usual work duration	3rd day	80% usual work duration
4th day	80% usual work duration	4th day	100% usual work duration
5th day	100% usual work duration		

*Workers returning from an absence

- G. Training/ Education and Evaluation:** Supervisors and employees must be trained to recognize symptoms of heat stress at the start of summer season (May to September) and prior to performing work in potentially high heat stress areas. Training must include hazard identification, heat stress symptoms and control techniques.
- H. Personal Protective Equipment:** Three variables are associated with clothing thermal balance: insulation, permeability and ventilation. Cotton clothing provides most of these variables. Clothes should be made of thin cotton (eases evaporation) loose fitting, light in weight and color. Clothes

should be regularly washed to remove the sweat and salt which can irritate the skin and lead to infection. Specialized PPEs (Not Mandatory) can also be used for specific high risk activities and certain high risk zones. Specialized PPEs: 1) Evaporative Cooling Vests, 2) Protective Neck Cover attachable with helmet, 3) Evaporative Cooling Towel

4.4 HEALTH SURVEILLANCE & ILLNESS REPORTING:

Roles and responsibilities of identifying needs & implementation of Health surveillance or Toxicological Medical screening, lies with Medical Section of HSE Division. Generally industrial hygiene Exposure Monitoring Data and Risk Categorization of each Similar Exposure Groups (SEG) are the basis of defining medical surveillance program. QAPCO’s detailed medical surveillance program can be prepared separately or can be merged with Employees’ periodical medical checkup programs. QAPCO Medical section-HSED, shall be responsible for reporting any heat related case recorded at medical center.

4.5 MONITORING OF EFFICIENCY OF THE PLAN:

This HSE Instruction is a technical guideline for Heat stress management process at QAPCO. All the sections and other relevant information pertaining to this guideline shall be reviewed and updated as per the requirements. Auditing of procedure implementation shall be conducted in-line with set schedule of Internal or External HSE Audit Plan. For regular monitoring of the efficiency of this procedure implementation, we have developed forms and check-lists as described in Appendix-5. These forms and check-list are used by field HSE Staff/Safety agents to physically evaluate & monitor the Rest Shelter condition and other parameters for heat stress prevention.

Effectiveness of Heat-Stress Management Plan is reviewed Annually based on: 1) Medical treatment or first aid cases 2) Near miss or safety observation 3) Safety suggestions 4) Site Surveys and 5) HSE Audits



5 RECORDS

The owner / executor shall maintain the following records / documents for reference:

#	Document / Record name	Retention period	Retention policy	Retention method	Classification
1	Heat stress injuries- Medical cases	5 Years	QAPCO Medical Team will maintain records	Soft	Internal
2	Inspection & Audit Report	5 Years	SED will maintain records	Soft	Internal

6 DOCUMENT REFERENCES / ATTACHMENTS

#	Document ID	Document name	Summary of dependency or use
6.1 DOCUMENT REFERENCES			
1	VI-IHH-GDL-004	Guideline for Heat-stress Prevention Program in Industrial Cities- QatarEnergy.	Reference
2	Heat Index Calculator	NOAA- National Weather Services-USA, Meteorological Conversions and Calculations.	Section-5, Heat Index Calculation Formula
3	Chapter-4, sec-III	OSHA Technical Manual- Heat Stress.	Reference
4	CDC. GOV	NIOSH Acclimatization fact sheet	Reference
6.2 ATTACHMENTS			
1	IN-SE-01-AP01	Heat Illnesses - Symptoms & First aid	Procedure Implementation
2	IN-SE-01-AP02	Sample HSM Plan (Applicable for Contractors)	
3	IN-SE-01-AP03	Heat-Stress Incident Questionnaire	
4	IN-SE-01-AP04	Urine Colour Chart (to Evaluate Dehydration Level)	

7 ABBREVIATIONS / DEFINITIONS

#	Abbreviation / Key word	Definition summary
1.	Acclimatization	Physiological adjustments made by an individual in response to regular exposure to heat or cold. In the case of heat, some of the adjustments made include sweating sooner in response to heat stress, lowering of the salt content in perspiration, slower heart beat and improvement in the blood flow to the skin. It does NOT make an individual immune to heat illness.
2.	Buddy system	Pairing of co-workers or team members for the purpose of health protection and looking out for one another.
3.	Conductive Heat	A direct means of transferring heat from a warmer body to a colder body by direct contact.
4.	Convective Heat	An indirect means of transferring heat from heated air around or near a hot surface to a cooler body.
5.	Heat Stress	The changes that occur in an individual in response to increases in body temperature
6.	Heat Cramps	Muscle spasms induced by hard work in intense heat, accompanied by severe pain; often related to body fluid or electrolyte deficiencies or imbalances. Some cases have been attributed to prior overindulgence in alcohol.

7.	Heat Exhaustion	A form of heat illness caused by excessive loss of fluid and/or electrolytes. Signs and symptoms include cool, clammy and pale skin, nausea, vomiting, profuse sweating, headaches, trembling, weakness and a rapid, weak pulse.
8.	Heat Stroke	A LIFE-THREATENING heat illness in which the body temperature rises drastically, usually above 40 °C. Its symptoms include skin which is hot, flushed, and dry (sweating has stopped), a rapid weak or bounding pulse, increased respiratory rate, decreased level of consciousness, seizures, and/or coma.
9.	Radiant Heat	Heat that is transferred to a cooler body by absorption of infrared rays from a heated surface or the sun.
10.	Heat Index (HI)	An index that combines air temperature and relative humidity in an attempt to determine the human-perceived equivalent temperature.
11.	PPE	Personal Protective Equipment
12.	COO	Chief Operations Officer
13.	CHSEQO	Chief Health, Safety, Environment & Quality Officer
14.	HSEQGM	Health, Safety, Environment & Quality Group Manager
15.	SEM	Sustainability & Environment Manager
16.	SHO	Sr. Hygiene Officer

8 REVISION HISTORY

Rev #	Date	Section No.	Reason for revision / modification
01	10.01.2017	All	Aligned and revised as per new organization and BT-4 documents. This Instruction supersede IN-320-MED-02
02	01.02.2018	Sec.- 7,8,10	Amendments, Additional information, Clarification and detailed description. RASCI chart updates, Section 8.3: Information addition, Appendix-4: More clarification Integration of QVC Procedure on Heat Stress Prevention (P-VGEN-624)
03	01.04.2019	Sec.8	Amendments, Additional information and Clarification on Heat- Index Table.
04	As per ISO Achiever Publishing Date	All	Changed instruction number from IN-253-ENV-01 to IN-SE-01 and revised as per new template requirement.