Business Procedure

Working in Hot or Cold Environments

Document Number – OHS-PROC-24

This document applies to the following site(s):

Rockhampton Office	☐	**Brisbane Office**	☐	**Tarong Site**	☒
Barron Gorge Hydro PS	☒	**Kareeya Hydro PS**	☒	**Mica Creek PS**	☒
Koombooloomba Hydro PS	☒	**Swanbank PS**	☒	**Mackay Gas Turbine**	☒
Wivenhoe Small Hydro PS	☐	**Stanwell PS**	☒	**Meandu Mine**	☐

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1.0 Purpose/Scope

This Business Procedure describes Stanwell's minimum mandatory requirements for assessing and managing the risks associated with working in hot or cold environments.

This Business Procedure applies throughout Stanwell, all its sites and all activities under Stanwell's control. It applies to all Stanwell employees and contractors, including visitors to Stanwell workplaces.

2.0 Background

Stanwell has production sites that are geographically located in areas that experience extremes in hot and cold environments. Exposure to extreme air temperatures, thermal radiation as a result of operation processes, or high levels of humidity can result in occupational illnesses or injuries.

3.0 Risk Assessment

A risk assessment shall be undertaken when workers are required to work in potentially extreme temperatures.

Both personal and environmental factors shall be considered when assessing the risk to workers' health from working in extreme temperatures. Acclimatisation of workers may be required in situations where the workforce is not sourced from the 'local' area e.g. contractors who have travelled from a cool/temperate climate to work in hot/humid conditions.

It shall be ensured that risks are controlled through the application of the hierarchy of controls to achieve the highest level of protection.

4.0 Hot Environments

The following risk factors shall be considered when identifying potential heat hazards:

- air temperature;
- humidity (in the environment);
- radiant heat (from the sun or other sources);
- air movement or wind speed;
- workload (nature of the work and duration refer to Appendix B, Table 2, for a guide to metabolic work rate);
- clothing (including protective clothing such as overalls, coveralls and suits that impede the body's ability to disperse heat). High levels of PPE/impermeable clothing inhibit sweat evaporation by producing a humid microclimate and diminishes the cooling effect of the evaporation that does take place; and
- individual risk factors - a number of physical/physiological characteristics of the worker will influence the capacity to tolerate work in the heat, including body size and general fitness:
    - overweight and physically unconditioned workers, will generally be more susceptible to heat stress;
    - older workers may not cope as well with hot work conditions (due to reduced cardiac function);
    - it is important to know if workers have a medical condition or are taking medication that may predispose them to heat illness. Examples of illnesses/medical conditions that may put the worker at a higher risk of heat illness include asthma, diabetes, pregnancy, heart conditions and epilepsy; and
    - workers who present with an illness such as a virus, flu or gastro or who are feeling unwell are at an increased risk of heat illness if working in moderate to hot weather.

The risk of heat injury or illness to workers shall be reduced via planning and implementing heat management strategies in accordance with the level of risk.

The following methods can be used as guidance in determining the level of risk:

- using the Thermal Work Limit (TWL) indices or the Heat Strain Model to provide an estimation of heat stress exposure (Refer to Appendix B); and
- monitoring of work/rest break cycles, water consumption, heat stress symptoms etc.

The monitoring of the workers' environment and physical well being when work involves prolonged or repeated exposure to conditions with the potential for heat stress shall be undertaken. Signs and symptoms of heat stress are included in Appendix D.

Where there is a high level or risk and the work is required to be carried out, physiological monitoring can be undertaken. When conducted, physiological monitoring shall be conducted by those with specialist knowledge and skills such as an occupational physician, experienced occupational hygienist, or physiologists.

4.1 Heat Management and Control

Controls identified should be included in the Work Method Statement. A range of heat management and control options, as per the hierarchy of control, include:

Elimination / Substitution

- Work scheduled to avoid the hottest part of the day.
- The design of buildings that house hot processes should, where possible, incorporate good air flow through positioning of windows, shutters and roof design to encourage 'chimney effects' to help dissipate the heat from the structure.
- Reflective or light-coloured external cladding and roofing can reduce internal temperatures.

Engineering / Job Redesign

- Air circulation sufficient to allow evaporation of sweat (the body's principal cooling mechanism). In high humidity more air needs to be moved, hence higher air velocity is required. This can be facilitated by fans or, in extreme cases, cooled air from 'chiller' units.
- Barriers may be useful where radiated heat from a process is a hazard. Barriers may be highly reflective surfaces such as aluminised sheeting or even tarpaulins.
- Wherever practical, hot pipes or ductwork shall be lagged or insulated to prevent the addition of heat to the work environment.
- Reduce worker's metabolic rate / workload via job redesign and/or use of mechanical aids to assist in carrying out manual tasks.

Administrative Controls

- Ready access to cool palatable drinking water.
- A clean cool area for workers to rest and recuperate. Whilst resting in the work environment can provide some relief for the worker, the level of recovery is much quicker and more efficient in an air-conditioned environment.
- For field teams with high mobility, a simple shade structure or large umbrella can provide relief from solar radiation.
- Utilise work-rest regimes where engineering controls are insufficient to protect the individual.
- Training workers to identify symptoms and the potential onset of heat-related illness and working as part of a 'buddy system.'
- Self-determination or pacing of the work to meet the conditions.
- Provide opportunities for workers who are not used to working in hot conditions to acclimatise, for example job rotation, slowly 'easing' into a new job in hot conditions, more regular rest breaks etc.
- Ensure light clothing is worn (where possible and according the task being undertaken) to allow free movement of air and sweat evaporation.
- Ensure trained personnel are available to manage heat injuries and designated recovery areas for workers affected by heat illness.

Personal Protective Equipment (PPE)

- PPE such as cooling vests with either 'phase change' cooling inserts (not ice) or vortex tube air cooling may be used in some situations, particularly when a cooling source is required when supplied air respirators are used (ice or chilled water can result in contraction of the blood vessels, reducing the cooling effect of the garment, so are not recommended to be used).
- Outdoor workers shall be provided with protection against ultraviolet exposure, such as wide brim hat, loose fitting, long-sleeved collared shirt and long pants, sunglasses and sunscreen.

5.0 Cold Environments

The following risk factors shall be considered when identifying potential cold hazards:

- air temperature;
- air movement (wind speed, refer to Appendix C for Wind Chill Temperature Guidelines);
- humidity (wetness - water conducts heat away from the body 25 x faster than dry air); and
- work load (nature of the work and duration).

The risk of cold injury or illness shall be reduced via planning and implementing cold management strategies in accordance with the level of risk.

Signs and symptoms of cold related stress are included in Appendix D.

5.1 Cold Management and Control

A range of cold environment control options, as per the hierarchy of control, include:

Elimination / Substitution

- Provide heated warming shelters whilst undertaking work.
- Where possible undertake tasks in the warmest part of the day.

Engineering

- Tools with metal handles shall be covered by thermal insulating material when used in sub-zero climates.
- Machines and tools should be designed so that they can be operated without having to remove mittens or gloves.
- Provide protection from wind and rain.

Administrative Controls

- Appropriate training of employees in relation to cold exposure.
- Work/rest regimes in warm shelters can protect employees working in cold environments with an equivalent chill temperature below -7°C.
- Work output should be controlled to minimise heavy sweating; where this cannot be avoided, individuals shall be encouraged to take rest breaks to allow them to change into dry clothes.
- Controlled exposure to cold utilising a work/rest schedule.
- Alternate work environments, provide opportunities for workers who are not used to working in cold conditions to acclimatise, for example, job rotation and regular rest breaks.
- Drink warm, sweet beverages preferably caffeine free.
- Consumption of warm, high-calorie foods (e.g. pasta).

Personal Protective Equipment

- Protective clothing is needed for continuous work at or below 4°C.
- Selection of suitable clothing (waterproof where necessary) that can be layered (without impeding the task and introducing new hazards) to adjust to changing environmental conditions and provide protection of extremities with hats and gloves. These factors are important to consider so that worker's can regulate the amount of heat and perspiration they generate while working. If the work pace is too fast or if the type and amount of clothing are not properly selected, excessive sweating may occur. The clothing next to body will become wet and the insulation value of the clothing will decrease dramatically. This increases the risk for cold injury.

6.0 Training and Competence Requirements

It shall be ensured that all workers involved in working in hot and cold environments are trained and competent as per Stanwell's requirements.

7.0 Review, Consultation and Communication

Review:
This Document is required to be reviewed, as a minimum, every 5 years.

Consultation:
Personnel consulted during the review of this document include the Manager Health and Safety Corporate, GM Health Safety and Environment Services and the EGM Safety and Asset Services, as well as any other personnel who have an interest in the process.

Communication/Requirements after Update:
This Business Procedure will be communicated to sites by an e-mail from the Manager Health and Safety Corporate and on GenNet.

8.0 References

Source	Reference
Legislation	• Queensland Work Health and Safety Regulation 2011 • Queensland Managing the Work Environment and Facilities Code of Practice 2011
Australian Standards	• ISO 7243 Hot Environments – Estimation of the heat stress on working man, based on the WBGT-index (wet bulb globe temperature)
Business Procedures	• Remote and Isolated Work Safety OHS-PROC-127
Stay Safe	• Working in Hot or Cold Environments OHS-PROC-24A
Tools	• Nil

9.0 Definitions

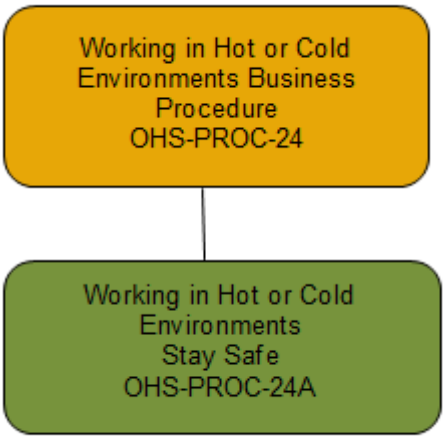
Term	Meaning
Acclimatisation	Is the state resulting from a physiological adaptation process which increases the tolerance of an individual when they have been exposed to a given environment for a sufficient period of time. In comparison with an individual who is not acclimatised, an individual who is acclimatised shows less physiological strain for the same heat/cold stress.
Metabolic rate	Rate of energy (heat) production of the body which varies with the level of activity.
Wet Bulb Globe Temperature (WBGT)	Is a composite temperature used to estimate the effect of temperature, humidity, wind speed ('wind chill'), and visible and infrared radiation (e.g., sunlight) on humans. It is determined with special equipment and calculated to reflect components of air, humidity and wind that affect 'actual temperature' experienced by personnel: WBGT is derived from the formula: 0.7Tw + 0.2Tg + 0.1Td T_w = Natural wet-bulb temperature (with dry-bulb temperature indicates humidity) T_g = Globe thermometer temperature (also known as black globe thermometer) T_d = Dry-bulb temperature (actual air temperature)

10.0 Revision History

Rev No.	Rev. Date	Revision Description	Author	Endorse/Check	Approved By
0	18.07.2016	Consolidation of legacy documents into one Business Procedure.	Jan Fullard	Michael Joy / Trevor Hooper	Ian Gilbar

11.0 Appendices

Appendix A: Working in Hot or Cold Environments Document Flowchart



Appendix B: Thermal Work Limit and Heat Strain Model

Note: Data provided is for use with the Calor Heat Stress Monitor (V2)

Thermal Work Limit

Thermal Work Limit (TWL) is a heat stress index and represents the sustainable metabolic rate that a well hydrated, acclimatized worker can maintain in a specific thermal environment within safe limits of core body temperature and sweat rate. TWL is an integrated measure of the dry bulb temperature, wet bulb temperature, wind speed and radiant heat. The TWL predicts the maximum level of work that can be carried out in a given environment, without workers exceeding a safe core body temperature (38.2°C) and sweat rate of <1.2kg per hour.

Environmental parameters cannot be used when assessing heat stress of workers wearing impervious suits e.g. Goretex chemical suits, aluminium foil suites, splash coats. The conditions inside the suits are different to outside the suits. The body is not cooled by evaporation of the sweat or be convection.

To calculate the Thermal Work Limit the metabolic work rate needs to be identified as per Table 2.

Table 1: Thermal Work Limit (TWL)

Zone	TWL (W/m²)	Recommendations
Unrestricted Work	**>220**	No Limits on self-paced work for educated, hydrated, acclimatised workers.
Acclimatisation Zone	**220-140**	• Affects new workers or those who have been off work for more than 14 days due to illness or leave (outside the tropics), should follow the Buffer Zone recommendations. • Acclimatised workers allowed to work but should not be alone. • Personal water bottle (2 litres) must be available.
Buffer Zone (Cautionary)	**140-115**	Any practicable intervention to reduce heat stress should be implemented e.g. provide shade, improve ventilation etc. • Working alone should be avoided if possible. • Un-acclimatised workers not to work in this zone. • Fluid intake of ≥1 litre per hour required, personal water bottle (2 litres) must be available. • Work-rest cycling or rotation required. • Wear cooler vests.
Withdrawal Zone (Restricted)	**<115**	Work limited to essential maintenance or rescue operations. • No person to work alone. • No un-acclimatised person to work. • Shield form radiant heat e.g. sun or machinery. • Increase wind speed/ ventilation. • Wear cooler vests • Apply 20 minutes work-40 minutes rest schedule. • Dehydration testing recommended at end of shift • Personal water bottle (2 litres) must be available at all times.

Table 2: Guide to Metabolic Work Rate (Workload) Categories

Work Rate			
Level	**Rate**	**Watts of Allowable Work**	**General Examples**
1	**Resting/ sedentary**	<105	Resting
2	**Very light work rate**	105-150	Sitting driving a car or standing in observation. Light hand and arm work. Casual walking.
3	**Light work rate**	150-250	Standing to control machines. Light use of arms and trunk, casual walking.
4	**Moderate work rate**	250-425	Walking at around 4.5 km/h, light digging, moving light wheelbarrow. Sustained hand, arm and truck work e.g. hammering.
5	**Heavy work rate (flat out short bursts of activity)**	425-600	Intense arm and trunk work. Sawing hard wood, carrying heavy materials, moving heavily loaded wheelbarrows, carrying loads upstairs or digging.

Heat Strain Model

The Heat Strain Model allows for some configuration of clothing and work level and provides recommendations for work rest cycles and fluid intake. The Heat Strain Model is based on the Wet Bulb Globe Temperature (WBGT and gives a maximal exposure limit in a measured environment, a work rest cycle regime and recommended water intake), the work level utilised in this calculation is determined by the table in Appendix B: Guide to Metabolic Work Rate (Workload) Categories.

Environmental parameters cannot be used when assessing heat stress of workers wearing impervious suits e.g. Goretex chemical suits, aluminium foil suites, splash coats. The conditions inside the suits are different to outside the suits. The body is not cooled by evaporation of the sweat or be convection. This level of PPE cannot be utilised in this calculation.

Table 3: Work/Rest Results

Work/Rest Results		
Work Rest	No limit	No limit required for this environment when optimum water is supplied.
	Ext cooling	External cooling is required with optimum water
	xx min/hr	Continuous work and rest cycle of xx minutes per hour, with optimum water,
Max Work	Xx min	The maximum number of minutes that can be worked continuously without a rest.
Opt Water	Optimum intake of water in litres per hour.	
Max Water	Maximum intake of water in litres per hour.	

Appendix C: Wind Chill Temperature Guidelines

At any temperature, it feels colder as the wind speed increases. The combined effect of cold air and wind speed is expressed as a“wind chill" temperature in degrees Celsius or Fahrenheit. It is essentially the air temperature that would feel the same on exposed human flesh as the given combination of air temperature and wind speed. It can be used as a general guideline for deciding clothing requirements and the possible health effects of cold environments.

WIND CHILL CHART

		Ambient Temperature (∞C)								
		4	-1	-7	-12	-18	-23	-29	-34	-40
Wind km/h	**Velocity mph**	**Equivalent Chill Temperature (∞C)**								
Calm										
0	**0**	4	-1	-7	-12	-18	-23	-29	-34	-40
8	**5**	3	-3	-9	-14	-21	-26	-32	-38	-44
16	**10**	-2	-9	-16	-23	-30	-35	-43	-50	-57
24	**15**	-6	-13	-20	-28	-36	-43	-50	-58	-65
32	**20**	-8	-16	-23	-32	-39	-47	-55	-63	-71
40	**25**	-9	-18	-26	-34	-42	-51	-59	-67	-76
48	**30**	-16	-19	-22	-36	-44	-53	-62	-70	-78
56	**35**	-11	-20	-29	-37	-46	-55	-63	-72	-81
64	**40**	-12	-21	-29	-38	-47	-56	-65	-73	-82

Adapted from: Threshold Limit Values (TLV™) and Biological Exposure Indeces (BEI™) booklet; published by ACGIH, Cincinnati, Ohio

Little danger in less than one hour exposure of dry skin

DANGER – Exposed flesh freezes within one minute

GREAT DANGER – Flesh may freeze within 30 seconds

Note on Wind Speed: The following is a suggested guide for estimating wind speed if accurate information is not available:

- 8 km/h (5 mph): light flag moves,
- 16 km/h (10 mph): light flag fully extended,
- 24 km/h (15 mph): raises newspaper sheet,
- 32 km/h (20 mph): causes blowing and drifting snow.

Appendix D: Signs and Symptoms of Heat or Cold Related Illness/ Health Effects

Work Environment	Possible Effects
Hot	**Heat Exhaustion** • Flushed skin • Sweating • Fatigue • Dizziness and fainting • Nausea and vomiting • Headaches • Weakness • Pale clammy skin **Heat Stroke** • Dry, pale skin with no sweating • Hot, red skin that looks sunburned. • Mood changes, irritability, confusion or the inability to think clearly. • Inability to revive from an unconscious state.
Cold	• Hands becoming numb • Shivering • Loss of fine motor co-ordination • Slurred speech • Difficulty thinking clearly • Irrational behaviour

Immediate assistance should be provided if any worker shows any of these warning signs of heat or cold related illness.