Heat Policy APPENDIX 1

HEAT STRESS RISK INDEX (HSRI)

Collectively, there are four environmental parameters and two personal parameters that determined the prevailing thermoregulatory strain during exercise in the heat.

THE ENVIRONMENTAL PARAMETERS ARE:

- Air temperature (in the shade)
- Humidity
- Wind speed
- Radiant temperature (from the sun)

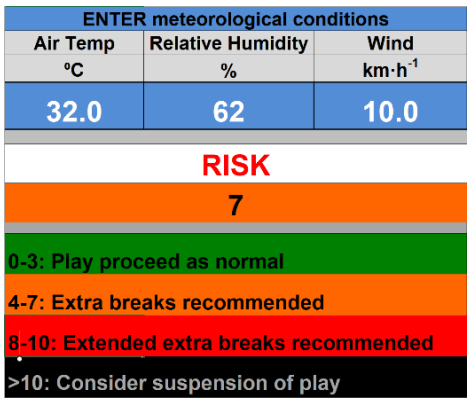
THE PERSONAL PARAMETERS ARE:

- Clothing properties (insulation and evaporative resistance)
- Activity (metabolic heat production)

A simple cut-off temperature therefore cannot be used as decision-making tool for preventing heat stress risk during cricket competition. Instead, the Heat Stress Risk Index (HSRI) combines all six of these factors to provide a "risk" rating from 0 to 10.

Of the two personal parameters, both are estimated and already built into the HSRI model. Average activity levels for the most active cricket positions are estimated to be 4 "Metabolic Equivalents" (METs) (Jette et al. J Clin Cardiol; 1990). Clothing properties have been measured for a standard cricket uniform (legs pads, trousers, short sleeve shirt, gloves, shoes) provided by Cricket Australia using a 34-zone sweating thermal manikin. Evaporative resistance was measured as 0.023 m2×kPa×W-1 and dry heat transfer resistance was determined to be 1.03 clo (0.160 m2×°C×W-1).

Location-specific hourly weather data will be extracted from the Bureau of Meteorology (BOM) website (http://www.bom.gov.au) for air temperature (in °C), relative humidity (in %), and wind speed (in km×h-1). *Note: **These hourly data and not peak data must be extracted as the highest relative humidity will not coincide with the high air temperature in a given day**. Radiant temperature (additional thermal effect of direct heat from the sun) is not measured by BOM, but will be estimated using the date, time, and location.



Air temperature, humidity, and wind speed are HSRI platform inputs in Excel (Fig.1). The accompanying output provides a "risk" rating from 0-10 with associated interpretation bands (green [0-4]; orange [5-7]; red [8-10]; black [>10]). Each band has a recommended action (see Clause 5.4).

The HSRI rating is based on the combined heat stress risk associated with the development of overheating (hyperthermia) and dehydration throughout the course of a full-day cricket match.

The risk of hyperthermia is determined estimating the physiological "compensability" of the player in the ambient environment. Humans predominantly keep cool during exercise in the heat via the evaporation of sweat. However, sweat evaporation is slowed down by low wind speeds and high humidity. The amount of evaporation required to stop overheating (Ereq), which becomes greater when air

temperature is high with clear skies, is compared to the maximum amount of evaporation possible (Emax). If Ereq is more than 100% of Emax, the body gets continually hotter. However fit trained people are known to be able to tolerate conditions when Ereq is up to 150% of Emax. But as this percentage becomes progressively greater, the risk of overheating gets worse. The HSRI "risk" value therefore increases by +1.0 for every 10% Ereq is above 150% of Emax.

Because the amount of sweating needed for a given amount of evaporation is known (2.427 $kJ \times g$ of $sweat^{-1}$), the rate of dehydration through sweating can be estimated. It is known that a 4% reduction in total body weight (TBW) through sweat losses can be detrimental to a person's health, therefore the risk associated with exceeding this threshold (for 80 kg male) throughout the course of a 3 x 2-h exposure is calculated using the HSRI. It is assumed that through the provision of fluids during breaks, the average player will replace ~50% of their sweat losses. So, a sweat rate of 1 $L \times h^{-1}$ is considered the threshold for increased risk of dehydration, and the HSRI "risk" value increases by +1.0 for every 0.1 $L \times h^{-1}$ the estimated sweat rate is above 1 $L \times h^{-1}$.

The risk scores for hyperthermia and dehydration are then combined to give a final overall HSRI "risk" value (Fig.1).