

Sunlight and other ultraviolet radiation risk management

Ultraviolet (UV) radiation, particularly solar, can be a significant health hazard to workers in mining and quarrying.

The risks of working in the sun

People who spend a lot of time in the sun risk developing skin cancer, other skin disorders, eye injuries, heat stress and heat-related illness. At least one out of two Australians can expect to develop some type of skin cancer; the result of over-exposure to the sun's ultraviolet (UV) rays.

UV light causes both acute (short-term) and chronic (long-term) health problems. These problems can be painful, disfiguring and sometimes fatal. Sunburn is painful evidence of overexposure, with sunburn that blisters considered a second-degree burn. Chronic effects include premature aging of the skin, cataracts and skin cancer.

What is the potential for serious injury?

Queensland has the highest rate of skin cancer in Australia. In recent years there has been a sharp rise in cases of melanoma, the deadliest form of the disease. Recent studies have clearly linked melanoma to sun exposure, especially to the intense exposure we experience in Queensland.

The risk of developing skin cancer increases with lifetime UV exposure. The risk of malignant melanoma also increases with the number of sunburns experienced during childhood. Lighter-skinned people are more likely to develop UV-related skin cancers than persons with darker skin, so they should take more precautions to minimize UV exposure.

What is ultraviolet radiation?

UV radiation is a form of electromagnetic radiation, like radio waves, x-rays, and light. It is also sometimes called 'ultraviolet light'. It is divided according to its effects on living tissue into three wavelength bands:

- UVA – responsible for pigmentation of the skin
- UVB – potentially most harmful
- UVC – absorbed by the air, blocked by the Ozone layer.

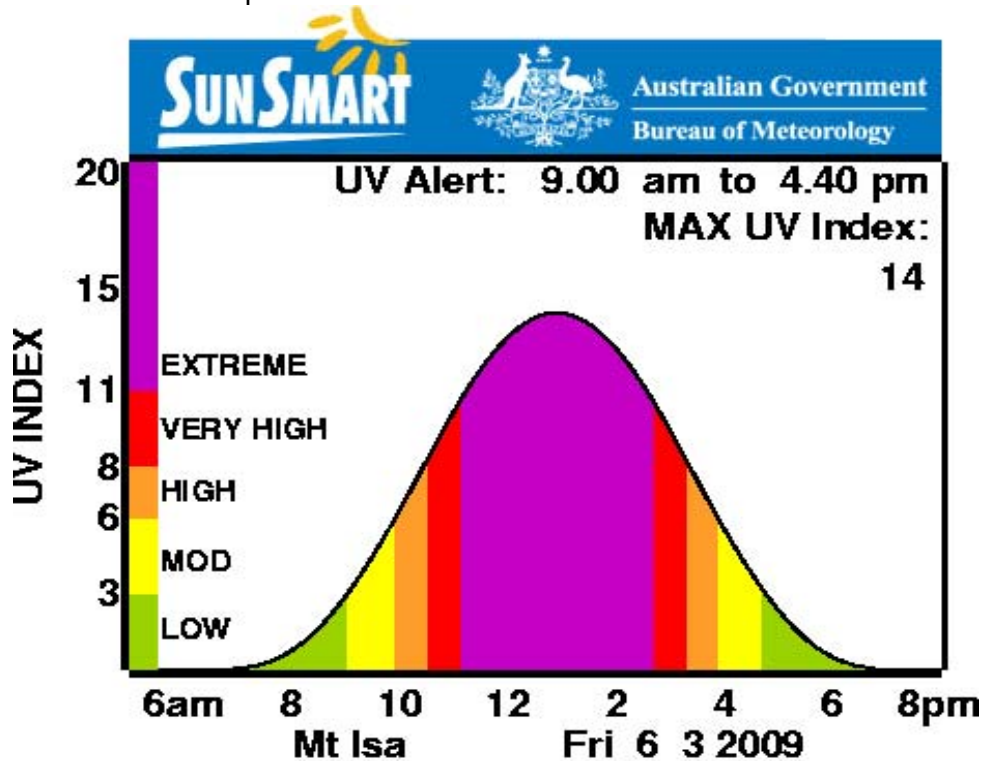
Sources of UV radiation in the workplace include various kinds of welding arcs and UV lamps. The sun is the main source of UV radiation outdoors.

What is the UV Index?

The Global Solar UV Index is a rating system adopted in Australia, based on guidance from the World Health Organisation (WHO). The higher the Index value, the greater the potential for damage to your skin.

In most of Queensland, at least for part of the day, there is potential for the UV index to rate from very high to extreme.

The UV index is reported daily by the Bureau of Meteorology (www.bom.qld.gov.au) for the majority of locations in Queensland. An example of the UV index follows:



Note: The exposure categories are based on the response of fair-skinned people to UV radiation.

Who is exposed to ultraviolet radiation in mining and quarrying?

Obviously, natural UV exposure can be a risk in activities on open-cut mines, quarries and exploration sites, but such sites should also consider the risks from artificial UV sources, such as welding, that may expose workers to excessive UV radiation.

What are the short-term health effects of UV radiation?

Skin **Sunburn** is reddening of the skin, with blistering and peeling in severe cases. Of the three UV bands, UVB is the main cause of sunburn. To protect itself against UV radiation, the skin 'tans' – that is, the pigment that gives the skin its colour becomes darker and more of it is produced.

Prolonged exposure to UV radiation causes a thickening of the skin's outer layer. Since people with lighter skin, hair and eyes have less pigment, they are more sensitive to UV exposure. Damage to the skin accumulates over the course of the day, and the injury does not become obvious until a few hours later. Given time, sunburned skin repairs itself.

Eyes **Welder's flash**, also known as flash burn, is a painful irritation of the membrane connecting the eyeball to the inner eyelid. There is a feeling of 'sand in the eye'. **Acute retinal burn**, is due to laser exposure or looking directly at the sun.

The eye is more sensitive than the skin to UV radiation because it lacks the skin's outer layer and protective pigment. Symptoms appear from 6 to 24 hours after exposure and usually disappear within the following 48 hours. No permanent damage to the eye results unless a severe exposure has occurred for welder's flash or a retinal burn.

What are the long-term health effects of UV radiation?

Skin **Skin cancer** is directly linked to UV radiation overexposure. Excessive exposure to UV radiation over many years has been shown to increase a person's risk of developing skin cancer. The most common types of skin cancer are not usually life-threatening if treated early. Malignant melanoma is a rarer but a much more dangerous form of skin cancer. The chance of developing skin cancer increases with a person's lifetime UV exposure. The risk of malignant melanoma also increases with the number of blistering sunburns experienced during childhood.

Photoaging is the premature aging of the skin caused by chronic exposure to UV radiation. The resulting changes in the skin include excessive wrinkling, dark spots, loss of elasticity and a leathery appearance.

Eyes **Retinal burn** produces no sensation of pain, but it can result in permanent eye damage or severe loss of vision.

Cataracts produce a clouding of the lens of the eye, resulting in impaired vision. They are usually caused by UV and infrared rays.

Pinguecula is a small yellowish lump or patch that appears on the white of the eye, near the cornea, mostly on the side closest to the nose. It is usually caused by excessive UV exposure. It may cause some 'gritty eye' irritation but usually requires no treatment.

Pterygium is a triangular fibrous growth on the white of the eye normally on the side closest to the nose. The apex points towards the cornea, the clear window, and may grow towards and across it causing problems with vision in that eye. Symptoms are mostly 'gritty eye irritation' until the cornea is affected.

Age related macular degeneration (ARMD) which is a multifactorial condition causing severe loss of vision in the elderly. The condition may be partly due to excessive sun exposure in early adulthood.

Potential UV sources in mining and quarrying

Source	Potential for overexposure	Hazard description
The sun	Extreme	UV from the sun is highest in spring and summer from 10 am to 2 pm, but most of Queensland exceeds the WHO UV exposure guidelines all year round, being extreme from spring and summer through to autumn. UV exposure for most locations in Queensland are available from the Bureau of Meteorology (www.bom.gov.au).
Electric welding arcs	Very high	Welding arcs can exceed the UV guidelines in seconds within a few metres of the arc. Workers, bystanders and passers-by are often overexposed to UV from arcs.
UV lasers	High	Intense UV radiation at a single wavelength, with no visible light.
UV lamps (short and long wavelengths)	Medium	Some UV lamps are used in determining quality of mineral deposits such as Scheelite. Lamps with a short-wave UV capability carry the highest risk and may cause skin and eye damage if used without due care.

Limits and guidelines for UV exposure

ARPANSA (Australian Radiation Protection and Nuclear Safety Agency) is the regulator for exposure to radiation, including ultraviolet radiation. ARPANSA has set the Australian Exposure Limit (EL) for Occupational Exposure at 30 J/m² (joules per square metre). Key points on the exposure limit are:

- It includes all exposure to UV Radiation (UVR)
- The 30 J/m² is the total calculated over an 8-hour working day
- The exposure limit applies to unprotected skin and eyes
- DNA damage has been shown to occur at approximately half the EL.

Legislative requirements for management of UV exposure

Risk management under Queensland coal mining safety and health legislation

UV or solar radiation is a health hazard in Queensland and is a known carcinogen. Currently there are no specific requirements for health assessment or health surveillance under coal mining safety and health legislation.

The *Coal Mining Safety and Health Regulation 2001*, section 96, requires sites to have a standard operating procedure to protect persons from solar radiation. UV Radiation or Solar Radiation is also a documented hazard in the coal mine hazards database. As such, there should be a risk assessment for UV or solar radiation undertaken at each site in accordance with the Regulation.

Risk management under Queensland mining and quarrying safety and health legislation

There are no specific requirements under this legislation, but UV or solar radiation is a health hazard in Queensland and is a known carcinogen. Section 7 of the Queensland *Mining Safety and Health Regulation 2001* requires that analysis of risks be undertaken, with consideration of the following:

- (a) the results of hazard identification, risk monitoring and incident investigations carried out for the mine
- (b) the work environment and work methods for the mine's operations
- (c) the interaction of hazards present at the mine
- (d) the effectiveness and reliability of hazard controls in use at the mine
- (e) other reasonably available relevant information and data from, and practices in, other industries and mining operations.

Under part (e), information and data would include, but not be limited to:

- ARPANSA (2006) Radiation Protection Standard: Occupational Exposure to Ultraviolet Radiation www.arpansa.gov.au/pubs/rps/rps12.pdf
- Safework Australia (2008): Guidance Note for the Protection of Workers from the Ultraviolet Radiation in Sunlight, available from www.safeworkaustralia.gov.au/swa/HealthSafety/HazardsSafetyIssues/UltravioletRadiationinSunlight.htm

Identifying risk of UV based on mining activity

There will be differences in UV risk depending on the type of activity. Some examples of UV risk associated with solar radiation in mining and related activity include:

- **Exploration and Drilling – very high risk potential.** Most exploration and drilling sites are located in areas that have extreme exposure to UV with limited shade.
- **Open-cut Mining and Quarrying – high risk potential.** Most operational groups will have exposure. As well as exposure at work, fly in/fly out mining operations need to consider the camp and potential exposure of workers during the day while not at work.

- **Underground Mining – low risk potential.** As exposure to the sun is the main source of UV, many underground workers will have limited exposure. There are other groups who will be at risk, such as maintenance workers and others who spend only some of their time underground, as well as workers at the processing plant, maintenance workshops and other areas. It is important to consider the camp (when provided) and potential exposure to workers during the day at camp.

Key components of a UV risk assessment

1. Obtain information on UV levels at the site

- ☑ Use the UV index to determine levels across the year, and across the shift. Consider the types of mining operation that have been identified as a high risk potential for UV.

2. Determine if an exposure assessment to gather information about work areas and potential UV exposure is required, or if you have sufficient information to determine risk.

- ☑ An exposure assessment should identify:
 - Scheduling of work
 - Break times and locations
 - Siting of work, including:
 - i. the shade provided by the physical environment in which the work is carried out
 - ii. reflective surfaces, for example, water, white surfaces such as sand, rock, or cement and unpainted corrugated steel or aluminium roofing, that are part of the environment in which the work is carried out
 - iii. any photosensitising substances associated with the work
- ☑ If levels are likely to be high, it may be necessary for measurement of personal exposure of certain high risk work groups.

3. Review existing measures in place that influence total UV radiation exposure, including:

- ☑ the current levels and availability of shade during outdoor work or rest breaks
- ☑ the degree of influence an employee has over their work schedule, for example, early starts
- ☑ the level of protection offered by sun-protective items, such as work clothing and personal protective equipment (PPE), currently provided to exposed workers.

Controlling the risk of UV occupational exposure

Applying the hierarchy of controls to UV risks could include the following:

Elimination

Consider if the work process or tasks can be eliminated. *As it is not practical to eliminate UV radiation in some mining tasks, such as exploration drilling or drilling generally, other control measures are needed.*

Engineering controls

Engineering controls include equipment or 'hard' barriers. For example: Shade structures over outdoor work areas and rest areas.

Administrative controls

Reorganise work practices to reduce exposure, and develop measures to ensure a safe system of work. For example:

- Make use of natural or artificial shade when practical
- Schedule other tasks during peak sun periods, between 11 am and 3 pm
- Increase the length and frequency of rest breaks to reduce exposure
- Sites can also increase size of crews to decrease individual exposure time to heat and UV rays
- Personal protective equipment (see further information below)
- Health surveillance (skin and eye checks for exposed personnel).

Appropriate clothing and personal protective equipment

Examples of appropriate PPE (from information from the Cancer Council and ARPANSA) are:

- broad brimmed hat (at least 8 cm)
- long sleeve, close weave shirt (see AS/NZS 4399: 1996)
- SPF 30+ sunscreen
- lip balm with an SPF of 15 or higher
- sunglasses (meeting the requirements of AS1067).

Further information on purchasing suitable clothing and personal protective equipment is available from ARPANSA, including:

- rating of UV protection of clothing, www.arpansa.gov.au/pubs/factsheets/Clothing_Bulletin_2008.pdf
- sunglasses and protection from solar ultraviolet radiation
www.arpansa.gov.au/pubs/factsheets/Sunglass_Bulletin_20081.pdf

The [ARPANSA UV exposure resource page](#) offers information about personal sun protection and products that claim to offer sun protection.

Training and Education

Training for workers exposed to UV radiation should be on-going and include induction of new workers.

The main components of the training should include:

- the health effects of solar and other UV radiation (including skin and eyes)
- main sources of UV on site
- who is at risk on site
- early recognition of skin changes and eye problems
- control measures provided on site
- reporting issues and ongoing awareness.

Monitoring and Review of Controls

When control measures have been implemented, a time frame is needed to evaluate the effectiveness of the control. Some sites at high risk may need to consider measurement of actual UV exposure using appropriately qualified professionals, as well as some form of surveillance.

Further Resources and Reading

- Cancer Queensland Guidance on Workplace Policy and Self Assessment
www.cancerqld.org.au/icms_docs/60243_SunSmart_Policy_Guidelines_-_Workplaces.pdf
- Sunsmart (Queensland) Guidance for workplaces
www.sunsmart.com.au/protecting_others/at_work/guidelines_and_policy
- Sunsmart Queensland General Resources
www.cancerqld.org.au/page/information_resources/resources_and_brochures/sunsmart_resources/
- United Nations Environment Programme (2005) Global Solar UV Index: A practical guide
www.unep.org/pdf/Solar_Index_Guide.pdf

Roger Billingham
Chief Inspector of Mines

Contact: Trudy Tilbury, A/Senior Principal Ergonomist, +61 7 4760 7412

Please ensure all relevant people in your organisation receive a copy of this Safety bulletin. Any such advice supplied to site should reach those who require it, and it should also be placed on the mine notice boards.

See more Safety alerts and Safety bulletins at www.dme.qld.gov.au/mines/safety_information_bulletins.cfm