



**Australian Government**

---

**Australian Radiation Protection and Nuclear Safety Agency**

## **Regulatory Impact Statement**

### **Radiation Protection Standard**

Occupational Exposure to Ultraviolet Radiation

---

## Table of Contents

<b>Table of Contents</b> .....	<b>2</b>
<b>Background</b> .....	<b>3</b>
Solar ultraviolet radiation .....	3
Solar UV-Index .....	3
Artificial sources of UVR .....	4
Statistics on skin cancer, cataracts & pterygium .....	5
Current regulations and guidelines .....	6
<b>Problems</b> .....	<b>7</b>
Lack of compliance and Associated Costs.....	7
<b>Objectives</b> .....	<b>10</b>
<b>Options</b> .....	<b>10</b>
<b>Impact Analysis</b> .....	<b>10</b>
Affected Parties.....	10
Cost-Benefit Analysis of Options .....	13
<b>Consultation</b> .....	<b>23</b>
<b>Conclusion and Recommendation</b> .....	<b>24</b>
<b>Implementation and Review</b> .....	<b>25</b>
<b>References</b> .....	<b>26</b>
<b>Abbreviations</b> .....	<b>28</b>

## Background

### Solar ultraviolet radiation

- 1 Exposure to ultraviolet radiation (UVR), in particular from the sun's rays, is a significant public health hazard and may increase with further depletion of the ozone layer. The possible health hazards range from short term effects such as sunburn and eye damage to chronic effects such as skin cancer and melanoma or cataracts. The energy in the UVR photons in the sunlight that reaches the earth's surface is sufficient to break chemical bonds in the molecules which make up the skin and eyes (such as DNA) and are capable of inducing significant biological damage. The magnitude of these biological effects varies with wavelength. The most significant adverse effects have been reported at wavelengths below 315 nm.
- 2 The most common acute effect of UVR on the skin is erythema (sunburn), which results in redness and blistering within eight to 24 hours after exposure. The severity depends on the duration of the exposure, the intensity of the UVR and the exposed person's skin type. UVR has also been shown to suppress the immune response in humans and may increase the risk of infection and decrease the effectiveness of the body's defence mechanisms.
- 3 The acute effects of UVR on the eyes are photokeratitis and photoconjunctivitis, which generally last for short time periods (24 to 48 hours) before they are reversed by the body's repair processes. Other effects of UVR on the eye may be acute retinal injury to aphakics and possible lens damage to individuals exposed to photosensitising agents. Chronic exposure to sunlight, especially the Ultraviolet-B (UVB) component, accelerates the skin's ageing process and increases the risk of developing skin cancer, both melanoma and non-melanoma. Chronic effects on the eye are cataracts and the development of pterygium and squamous cell cancer of the conjunctiva.

### Solar UV-Index

- 4 ARPANSA measures daily solar UVR levels using a network of detectors in Australian capital cities. The information is analysed and distributed daily to news services and interested organisations. UVR levels are reported as a 'Solar UV-Index', which is a measure of the highest level of UVR each day, taking into account cloud cover and other environmental factors. Solar UV-Index values are related to UVR exposure and recommended protection measures as shown in Table 1 below<sup>1</sup>.

**Table 1 – UV Index**

UV Index	Exposure Category	Precautions
0 to 2	Low	None necessary
3 to 5	Moderate	When the UV Index is 3 or above:
6 to 7	High	1. Seek shade 2. Wear protective clothing that covers your arms

<sup>1</sup> Source: *Sunsmart UV Alert*, Sunsmart 2006

8 to 10	Very High	and legs as well as your body.
11+	Extreme	3. Wear a broad-brimmed hat that shades your face and neck. 4. Wear wrap-around sunglasses. 5. Apply SPF30+ broad spectrum water resistant sunscreen every 2 hours.

5 Employers can use the Solar UV-Index as a guide to plan protection for their outdoor workers.

6 In Queensland, the Department of Industrial Relations has produced guidelines for employers of outdoor workers on how they may comply with Queensland's Workplace Health and Safety Act<sup>2</sup>. The guidelines are based on the Solar UV Index but also stipulate the maximum permissible continuous exposure of a person to solar UVR at each level of the Index. When followed diligently, these guidelines, which also refer to the exposure limits in the NHMRC standard, will help employers to reduce the exposures of workers and as well possibly comply with the exposure limits.

### Artificial sources of UVR

- 7 Exposure to sunlight is the major cause of UVR exposure for outdoor workers but other occupational groups can receive accidental exposure from equipment and devices that emit UVR. There are few artificial sources that result in human exposure to UVR greater than that from the sun. Exceptions are artificial sources used for medical therapy and diagnosis, and cosmetic tanning. Industrial sources are generally effectively enclosed, but accidental exposure may occur.<sup>3</sup> The spectrum of the UVR emitted from artificial sources varies from one source to another. Most man-made sources of UVR can be grouped together in the categories shown below.
- (a) Incandescent sources such as tungsten lamps, which are generally not hazardous;
  - (b) Gas discharges, for example,
    - low, medium and high pressure mercury lamps. Low pressure lamps are often used as germicidal and disinfection lamps. Mercury lamps with metal halides are used mainly for lighting, displays, floodlighting, printing, curing and other industrial applications;
    - xenon lamps, which are used in photography and as solar simulators;
    - hydrogen and deuterium lamps, and flash tubes;
  - (c) Electric discharges, for example, welding arcs are potential sources of severe retinal hazards due to their compact size and high luminance;
  - (d) Fluorescent lamps, such as, fluorescent lighting tubes, fluorescent sunlamps (UVB emitters) and fluorescent UVA tubes.
- 8 The health effects from over exposure to UVR from artificial sources are the same as those for solar UVR, namely, erythema and eye damage. However, as some artificial

<sup>2</sup> Available at <http://www.whs.qld.gov.au/safetylink/health/health07.pdf>

<sup>3</sup> *Environmental Health Criteria 160, Health and environmental effects of ultraviolet radiation*, UNEP/ICNIRP/WHO, Geneva, 1994, p.25

sources can emit more of the hazardous UVR wavelengths and at greater power, the time required to achieve these effects can be as short as a few seconds and the potential for more significant and even extreme health effects is very high.<sup>4</sup>

### Statistics on skin cancer, cataracts & pterygium

- 9 Each year, about 270,000 new cancer cases of non-melanocytic skin cancer are diagnosed in Australia. According to a 1995 survey, incidence rates for treated non-melanocytic skin cancers was an estimated 1,374 per 100,000 population for males and 857 per 100,000 population for females. These rates are 19 times the next most common male cancer (prostate) and 10 times the next most common female cancer (breast), using 1998 data. Despite non-melanocytic skin cancer's high incidence rate it has a relatively low mortality rate at 1.6 per 100,000 population compared with the high mortality rates of male lung cancer at 53.2 per 100,000 population, female breast cancer (22.8) and prostate cancer (29.5).<sup>5</sup>
- 10 About 6,000 cases of malignant and potentially fatal melanoma cases are reported annually in Australia. Although this is a low incidence rate compared to non-melanocytic skin cancer, it is among the highest melanoma incidence rates in the world. Melanoma risk in Australia is generally highest in the north and lower in the south, showing a correlation to exposure to UVR. Age-standardised mortality ranges from 2.5 deaths per 100,000 population for the NT to 5.8 deaths per 100,000 population for Queensland, making it more deadly than non-melanocytic skin cancer.<sup>6</sup>
- 11 According to the Cancer Council of Australia cancer costs an estimated \$2 billion in direct health system costs (6 per cent of total) and skin cancer is the most expensive, with annual costs in excess of \$300 million. There are also the associated costs of the 1000 to 1300 deaths each year from skin cancer, 70% to 80% of which are due to malignant melanoma.<sup>7</sup> A more recent study conducted in Queensland<sup>8</sup> concluded that there is a strong link between occupational exposure to UVR and occurrence of squamous cell carcinoma of the skin and that about 20% of cataract is caused by UVR.<sup>9</sup>
- 12 The United Nations Environment Programme has estimated that over 2 million non-melanoma skin cancers and 200,000 malignant melanomas occur globally each year. A 10% decrease in stratospheric ozone could, with current trends and behaviour, lead to an additional 300,000 non-melanoma and 4,500 melanoma skin cancers world-wide.
- 13 Some 12 to 15 million people in the world are blind because they have cataracts. The World Health Organisation has estimated that up to 20% of cataracts or 3 million a year could be due to UV exposure. It has been estimated that for each 1% sustained

---

<sup>4</sup> *Health Effects from Ultraviolet Radiation. Report of an Advisory Group on Non-Ionising Radiation*, Documents of the NRPB, Vol. 13 No. 1, 2002.

<sup>5</sup> *Cancer in Australia 1998: Incidence and mortality data for 1998*, (Cancer Series Number 17), Australian Institute of Health and Welfare and Australasian Association of Cancer Registries, Canberra, Oct 2001, p.8.

<sup>6</sup> *Cancer in Australia 1998: Incidence and mortality data for 1998*, (Cancer Series Number 17), Australian Institute of Health and Welfare and Australasian Association of Cancer Registries, Canberra, Oct 2001, p.17

<sup>7</sup> *Cancer in Australia 1998: Incidence and mortality data for 1998*, (Cancer Series Number 17), Australian Institute of Health and Welfare and Australasian Association of Cancer Registries, Canberra, Oct 2001, p.8.

<sup>8</sup> *Exposure to Ultraviolet Radiation in the Construction Industry – Audit Report*, Division of Workplace Health and Safety, Queensland, March 2002.

<sup>9</sup> See also WHO Environmental Health Criteria 160, 1994 found at <http://www.who.int/peh-uv/publications/english/who-ehg-95-16.htm>

decrease in stratospheric ozone there would be an increase of 0.5% in the number of cataracts caused by solar UVR. It costs the US Government US\$3.4 billion for 1.2 million cataract operations a year. Substantial savings in health care costs can be made by prevention or delay in the onset of cataracts.

- 14 In August 2005, the Cancer Council Australia and Centre for Eye Research released a joint position statement on Eye Protection relating to exposure to UV radiation. This statement quotes a report by Access Economics on the Economic Impact and Cost of Vision Loss in Australia (Aug 2004), which estimates that 10% of cataracts are potentially due to exposure of the eye to UV B radiation. The report further indicates that around 160,000 cataract cases are treated in Australia each year with direct health costs of \$327 million. The report also notes that indirect costs (including lost earnings, cost of carers, aids, equipment, home modifications and deadweight losses associated with transfer payments) of visual impairment (not just cataract) are almost twice the direct health costs.
- 15 An additional risk to the eye from UV radiation is pterygium, an overgrowth of the conjunctiva on to the cornea. It has been estimated by Wlodarczyk<sup>10</sup> et al that almost half of the 8,600 cases of pterygium treated annually in Australia are caused by sun exposure, and that the direct medical costs of pterygium in Australia are \$8.3m annually. Additional indirect costs such as loss of work time could not be measured and were not included in the study.

### Current regulations and guidelines

#### **Occupational health and safety laws and other guidelines**

- 16 The Commonwealth, State and Territory governments have legislated requirements for occupational or workplace health and safety. These include requirements for systems of work that are safe and without risk to health, preventing industrial injuries and diseases and protecting the health and safety of the public in relation to work activities. Some of the legislation refers to broad duties of care of employers to protect their workers from the harmful effects of UVR. Some jurisdictions publish bulletins and guidelines to explain how the public and workers can protect themselves from the harmful effects of UVR and how employers can identify and manage the risks to their workers from solar and other sources of UVR. Some jurisdictions also refer to standards and guidelines published by other agencies such as the NHMRC, Standards Australia<sup>11</sup>, the National Occupational Health and Safety Commission (NOHSC)<sup>12</sup> and ARPANSA<sup>13</sup>.
- 17 Attachment 1 summarises state and territory legislation relating to the workplace and current policies, guidelines and initiatives relating to occupational exposure to UVR.

---

<sup>10</sup> Wlodarczyk J, et al. Pterygium in Australia: a cost of illness study. *Clin Experiment Ophthalmol* 2001; 29: 370-375.

<sup>11</sup> For example, AS/NZS 1338 Parts 1,2 and 3 (1992) on eye protection and AS 4174: 1994 on Synthetic shade cloth.

<sup>12</sup> *Guidance Note for the Protection of Workers from Ultraviolet Radiation in Sunlight* [NOHSC: 3012 (1991)]

<sup>13</sup> *UV Resource Guide*, ARPANSA, 1999 (see [www.arpansa.gov.au](http://www.arpansa.gov.au))

### Exposure limit values

- 18 In 1989 the NHMRC published the *Occupational Standard for Exposure to Ultraviolet Radiation* as part of the NHMRC's Radiation Health Series (RHS 29) based on guidelines published by the International Non-Ionizing Radiation Committee of the International Radiation Protection Association (INIRC/IRPA) in 1985<sup>14</sup> and 1989<sup>15</sup>. In 1996, the International Commission on Non-ionising Radiation Protection (ICNIRP)<sup>16</sup>, confirmed the 1985 and 1989 recommendations<sup>17</sup>.
- 19 The NHMRC standard provides UVR exposure limit values for exposure of the eye or skin in the spectral region between 180 and 400 nanometres (nm). The exposure limit values are to be used as guides to evaluate potentially hazardous exposure from both pulsed and continuous sources of UVR where the exposure duration is not less than 0.1 µsec. The exposure limit values in the NHMRC standard do not differ from the ICNIRP Guidelines and essentially restrict radiant exposure on unprotected skin to no more than 30 joules per square metre (30 J/m<sup>2</sup>). This means that for an eight-hour day, the effective irradiance in a second should not exceed one milliwatt per square metre (1 mW/m<sup>2</sup>).
- 20 The NHMRC standard is currently the only publication in Australia that provides a scientific basis for the prescribed UVR exposure limit values in accordance with the ICNIRP Guidelines.

### Problems

- 21 Although the NHMRC standard does not have an expiry date it was published in 1989, is more than 10 years old (although the exposure limits and the spectral effectiveness values have been virtually unchanged since the early 1970's – they have not become out of date) and has been rescinded by NHMRC. Also, the NHMRC does not wish to continue publishing its RHS publications and ARPANSA has taken over the responsibility for review of the RHS publications.
- 22 An Australian Standard (AS 2243.5-1993: *Safety in laboratories - Non-ionizing radiations*) contains tables of maximum permissible eight-hour doses and exposure limits as well as a relative spectral effectiveness table across the wavelengths 200 to 320 nm. However, it is now out of date, and relevant only to laboratories.

### Lack of compliance and Associated Costs

- 23 The implementation of a standard on exposure to artificial sources of UVR is relatively straight forward. Employers need to measure the exposure from artificial sources used in the workplace (or obtain the information from manufacturers' specifications) and take action to limit occupational exposure or prevent accidental exposure. However, exposure limits for solar UVR are more difficult to comply with. To assess exposure of

---

<sup>14</sup> *Guidelines on Limits of Exposure to Ultraviolet Radiation of Wavelengths between 180 nm and 400 nm (Incoherent Optical Radiation)*, International Non-Ionizing Radiation Committee of the International Radiation Protection Association (INIRC/IRPA), 1985.

<sup>15</sup> *Proposed change to the IRPA 1985 Guidelines on Limits of Exposure on Ultraviolet Radiation*, International Non-Ionizing Radiation Committee of the International Radiation Protection Association (INIRC/IRPA), 1989.

<sup>16</sup> ICNIRP is the successor organisation of INIRC/IRPA.

<sup>17</sup> *Guidelines on UV Radiation Exposure Limits*, International Commission on Non-ionising Radiation Protection (ICNIRP), 1996.

outdoor workers, monitoring devices are required to measure solar UVR. The lease of such devices and laboratory measurement of the values recorded in the devices involve costs. This has led to a high degree of non-compliance with the exposure values in the NHMRC standard. There is also the question of practicality given the considerable variability from day to day and even within a single day, with changing weather patterns.<sup>18</sup>

- 24 Although there is no national data on this problem, a recent study in Queensland of 107 construction sites and 401 outdoor workers found that solar UVR exposure is not being taken seriously<sup>19</sup>. The study showed that 94.7% of the worker exposures exceeded the eight-hour exposure limit of 30 J/m<sup>2</sup> and another 2.8% of exposures reached 2/3<sup>rd</sup> of the exposure limit in a four-hour period and would probably have exceeded 30 J/m<sup>2</sup> if monitored for an eight-hour period. The study concluded that exposures were very high with 44% being between two and five times the exposure limit, 33% between five and 10 times and 7.3% more than 10 times the limit. Only 12% of workers were able to work in shade, even though 91% of workers sought shade for breaks when this was available or had meal breaks indoors. Also only 10% of workers were appropriately protected by wraparound sunglasses, a UPF-rated shirt with a collar and a broad brimmed hat (or collarless UPF-rated-shirt and brimmed hat with neck protector) with 30+ sunscreen being used every two hours. The Queensland study is assumed to be indicative of the compliance problem across most States and Territories in Australia.
- 25 There is some specific information available on workplace activities for Victoria from the Sunsmart Program. A 2001 survey found that 41% of the 100 top workplaces in Victoria have a written sun protection policy and that 76% of local government authorities have a written sun protection policy for council outdoor workers (and 26% also have one for contract outdoor workers) (Sunsmart 2000).
- 26 For some employers who have implemented sun protection policies, one of the obstacles has been changing the habits of outdoor workers who have worked without protection for many years and prefer to wear shorts and singlets and not to wear sunscreen.
- 27 In 2001 there were 80 worker compensation cases in Australia relating to exposure to the sun. These include 15 cases of malignant melanoma of the skin and 18 cases of carcinoma of the skin (NOHSC 2001). It should be noted that while melanomas are related to UVR exposure, they are not generally acknowledged as being strongly related to occupational UV exposure (Armstrong 2004).

---

<sup>18</sup> Given the difficulties with measurement and as a result of consultation on the earlier draft, the proposed Standard has been amended to remove compliance with limits for outdoor workers and to make it clear that measurement is not required.

<sup>19</sup> Exposure to Ultraviolet Radiation in the Construction Industry – Audit Report, Division of Workplace Health and Safety, Queensland, March 2002. Measured Solar Ultraviolet Radiation Exposures of Outdoor Workers in Queensland in the Building and Construction Industry. Peter Gies and Jill Wright. Photochem Photobiol, 78:342-348, 2003.

**Table 2 - State breakdown of workers compensation cases relating to the sun in 2001**

State/Territory	Number of cases
NSW	60
VIC	<6
QLD	11
WA	0
SA	<6
TAS	0
NT	<6
ACT	0
Total	80

Source: NOHSC Online Statistics Interactive Workers Compensation Statistics Database

- 28 A survey of 100 major companies that employed outdoor workers in Victoria in 1998 found one-fifth had received compensation claims from employees relating to skin cancer or sun damage. Claims had been lodged against 21% of organisations surveyed compared to 11% in 1996 (Sunsmart 2000).
- 29 As an example of the mechanism under which compensation cases are successful, the NSW Workers Compensation Act 1987 definition of “injury” includes:
- a disease which is contracted by a worker in the course of his employment and to which the employment was a contributing factor; and
  - the aggravation, acceleration, exacerbation or deterioration of any disease, where the employment was a contributing factor to the aggravation, acceleration, exacerbation or deterioration.
- 30 An Internet search in [www.austlii.edu.au](http://www.austlii.edu.au) showed instances in Australia when claimants had gone to court to prove adverse health effects caused by exposure to UVR. Many of these actions were brought by war veterans or their widows but there were also instances when employers were sued for compensation for skin cancer allegedly caused by occupational exposure to solar UVR. In one case in 2000, the executrix of a deceased bricklayer's estate successfully sued the deceased's employer, on behalf of his dependent children, for worker's compensation. The NSW Compensation Court held that the characteristics of the deceased's employment as a bricklayer gave rise to a material risk of melanoma from exposure to ultraviolet rays.<sup>20</sup>
- 31 Also, in May 2002, the Federal Court in Melbourne ruled that outdoor workers can claim the cost of sunglasses, sunscreen and hats as tax deductions.<sup>21</sup> In that case, the judge identified the following as issues although they did not arise for consideration in that proceedings:
- (a) whether it is desirable that members of the community in general, or outdoor workers in particular, use sun protection items when exposed to the sun;
  - (b) whether it is desirable that the community in general, or outdoor workers in particular, be educated about the risks of unprotected exposure to the sun and about the available protective measures

<sup>20</sup> Rankin v. Idoko Pty Ltd & Another, (2000) 19 NSWCCR 607

<sup>21</sup> Morris v Commissioner of Taxation (2002) FCA 616

- (c) whether employers should, or are obliged by law to, ensure that outdoor workers take appropriate steps to protect themselves against the sun
- 32 From the Queensland study cited above it is clear that previous legal action in courts by employees have not had a significant effect in influencing the level of compliance by Australian employers, especially in the construction industry.
- 33 The most significant source of potential exposure to man-made UVR is from arc welding equipment and the UVR from this equipment has the greatest potential to harm other people in the vicinity of the workplace where the equipment is being used. The levels of UVR emitted from arc welding equipment can be very high and potential for acute injury to the eye and the skin is great. Welding is also widespread throughout the community. For example, the Australian Bureau of Statistics 2001 Census of Population and Housing lists 48,706 persons as being employed as “Structural Steel and Welding Tradespersons”.

## Objectives

- 34 To reduce the risk of health effects arising from exposure to UVR in the workplace, both from artificial sources of ultraviolet radiation and from solar ultraviolet radiation.

## Options

The options that were considered are as follows:

- (a) Option 1 - Do nothing. Continue with the current NHMRC standard.
- (b) Option 2 – Self regulation by the industry.
- (c) Option 3 – Adopt the ICNIRP Guidelines as the Australian standard.
- (d) Option 4 – Implement an ARPANSA standard.

## Impact Analysis

### Affected Parties

- 35 Employers of outdoor workers. Table 3 shows estimates of the number of large and small employers in major industries that involve outdoor work.

**Table 3: Estimated number of *employers* in major industries involving outdoor work**

Industry	Large employers	Small employers
Rural	700	85,000
Construction	1,600	44,000
Transport	1,300	34,000
Gardens/nurseries/greenkeepers	500	13,000
Total employers	4,100	176,000

Source: Derived from ABS 2001 Census of population and housing and ABS 1321.0 Small business in Australia, small businesses defined as employing less than 20 people

- 36 There are many Australian workers potentially at risk from exposure to ultraviolet radiation. Outdoor workers, such as food and drink attendants, porters, tour guides, water sports instructors and attendants, tennis coaches, power boat drivers and deckhands, real estate agents, property managers, life guards and pool attendants, referees and umpires, security personnel, crowd controllers, construction workers and supervisors, door to door salespersons, letter droppers, handypersons, gardeners, cleaners, maintenance personnel, refuse workers, council employees, divers and dive masters, rafting and river guides, actors and traffic controllers.<sup>22</sup>
- 37 Table 4 shows the estimated number of employees in the major industries that involve outdoor work. The numbers of employees in the table have been aggregated from detailed occupation classifications from the Australian Bureau of Statistics 2001 census.

**Table 4: Estimated number of *employees* in major industries involving outdoor work**

Industry	Number of employees
Rural	270,000
Construction	260,000
Transport	210,000
Gardens/nurseries/greenkeepers	80,000
Total	820,000

Source: ABS 2001 Census of population and housing

- 38 Not all of the employees in Table 4 will necessarily be outdoor workers. For the purpose of generating an estimate of the likely number of outdoor workers, it is assumed that around 60% of employees working for large employers in these industries would be outdoor workers. For small employers it is assumed that all workers would be outdoor workers (as the average size small employer is estimated to have 3-5 employees). Table 5 shows the estimated number of outdoor workers.

**Table 5: Estimated number of *outdoor workers* for large and small employers in major industries involving outdoor work in Australia**

Employer type	Approximate number of outdoor workers
Large employers	200,000
Small employers	500,000
Total	700,000

<sup>22</sup> Source: Qstats (Office of Economic and Statistical Research, Queensland Government)

- 39 The most detailed study of workplace behaviour is the Queensland audit of exposure to ultraviolet radiation among construction workers (Queensland Division of Workplace Health and Safety, March 2002). The audit found that 95% of worker exposures exceeded the Australian 8-hour exposure standard of 30 J/m<sup>3</sup>. Only 10% of workers were appropriately protected. The audit concluded that there is a significant risk to Queensland workers from occupational UVR exposure.
- 40 For the purpose of this analysis it is assumed that 90% of outdoor workers are not protected, and hence the number of employees is 180,000 (large employers) and 450,000 (small employers).
- 41 Employers and employees in workplaces that use artificial sources of UVR are also stakeholders. This includes the printing and welding industries, hospitals and medical surgery.
- 42 For artificial sources of UVR, there is limited information available on the numbers, however the numbers of employers and employees is estimated as follows (Thinc Communications 2004).
- 43 Table 6 below provides rough estimates of the number of selected artificial sources of ultraviolet radiation derived from discussions with relevant stakeholders. The proposed ARPANSA standard does not apply to ultraviolet lasers and these have therefore been excluded from the analysis.

**Table 6: Estimated number of selected artificial sources of UVR in Australia**

Type of UVR device	Estimated number
Cosmetic solaría	600 <sup>1</sup>
Therapy devices	200 <sup>2</sup>
Transilluminators	> 200 <sup>2</sup>
Industrial/Laboratory equipment	>1000 <sup>2</sup>
Welding equipment	50,000+ <sup>3</sup>
Printing equipment	24,000 <sup>4</sup>

Sources:

1 ACCC press release 1997

2 pers. comm. Mr Lee Collins to Thinc Communications

3 Assumed similar to number of welders from ARPANSA 2003b

4 Assumed similar to number of printers from ABS 2001 Census of population and housing

- 44 In a NSW economic assessment of a 1997 guideline relating to ionizing radiation equipment used in radiation therapy there were 100 units being used in NSW and around 600 staff potentially exposed (NSW EPA 1997). In the absence of other information this ratio of 1:6 is used to estimate the number of workers operating ultraviolet radiation therapy equipment as well as other artificial sources. Table 7 provides estimates of the number of workers using selected artificial sources of UV.

**Table 7: Estimated number of workers using selected artificial sources of UV**

Type of UVR device	Estimated number of workers
Cosmetic solaria	300 <sup>1</sup>
Therapy devices	1,200
Transilluminators	1,200
Industrial/Laboratory equipment	6,000
Welding equipment	50,000 <sup>+2</sup>
Printing equipment	24,000 <sup>3</sup>

Notes:

1 Assumes an average of one worker for every two solarium beds

2 ARPANSA 2003b

3 Source: ABS 2001 Census of population and housing

- 45 Commonwealth, State and Territory governments, in particular, radiation protection and occupational or workplace health and safety agencies are also affected by the Standard.

### Cost-Benefit Analysis of Options

#### **Option 1 – Do nothing. Continue with the current NHMRC standard.**

- 46 The NHMRC standard provides UVR exposure limit values for exposure of the eye or skin in the spectral region between 180 and 400 nanometres (nm). The exposure limit values are to be used as guides to evaluate potentially hazardous exposure from both pulsed and continuous sources of UVR where the exposure duration is not less than 0.1 µsec. However, the NHMRC has said that it will not review this standard and has handed responsibility for the re-publishing of the standard to ARPANSA.

#### ***Option 1 - Benefits***

- 47 Under this option, governments would not have to spend resources to develop a standard, write or amend regulations to reference the standard and need not allocate resources to ensure that industry complies with the standard. Even though the NHMRC standard has been rescinded by the NHMRC, employers could use the ICNIRP:1996 recommendations as the exposure limits, as the NHMRC limits are the same as the ICNIRP Guidelines, which are now available free of charge from the ICNIRP website.
- 48 Industry would not have to expend additional resources for compliance.

#### ***Option 1 – Costs***

##### *Compliance Costs*

- 49 There is no certainty for employers and employees on how long the NHMRC standard could remain in place. In addition the NHMRC standard, in line with its voluntary nature, is ambiguous on compliance requirements as it uses words such as “should”.
- 50 As the NHMRC standard has been rescinded by NHMRC, employers could seek to comply with the ICNIRP Guidelines. However, employers and occupationally exposed

persons will have no way of knowing if the ICNIRP Guidelines are suitable for implementation in Australia, without constantly seeking guidance from appropriate regulatory agencies.

- 51 The NHMRC standard does not include any specific requirements for outdoor workers (e.g. risk management approach and protective measures – it only specifies non-mandatory limits) and has had no effect in modifying behaviour to reduce exposure, as evidenced by the Queensland survey (Queensland DWHS 2002). Hence it is likely that melanoma and other skins cancers will continue to increase at current rates of 6-7%. The cost of cataract is also increasing and is likely to have doubled by 2020.
- 52 As UVR is regulated in some jurisdictions at present, the current situation of non-uniformity would continue, adding to compliance costs for industry, particularly those that work across State boundaries and would need to be familiar with different requirements.

#### *Administration Costs*

- 53 Governments would not be able to ensure that employers are complying with the NHMRC standard (or the ICNIRP Guidelines) as both the NHMRC standard and the ICNIRP Guidelines are voluntary.

#### **Option 2 – Self regulation by the industry.**

- 54 Under this option the industry may either develop its own standard based on the ICNIRP Guidelines or adopt the ICNIRP Guidelines. The only motivation for to comply would be based on the threat of legal action for breach of duty of care.

#### *Option 2 - Benefits*

- 55 Governments would not have to spend resources to develop a standard, write or amend regulations to reference the standard and need not allocate resources to ensure that industry complies with the standard.
- 56 Industry would have the flexibility to introduce protective measures that suit its needs.

#### *Option 2 – Costs*

##### *Compliance Costs*

- 57 The recent Queensland study referred to above, and the fact that this high level of non-compliance was revealed notwithstanding previous court action by employees, shows that employers have largely not complied with the existing NHMRC standard. This suggests that a continued voluntary standard is unlikely to improve compliance levels.
- 58 Occupationally exposed persons are likely to prefer limits to be well defined and enforced by regulators. This is because even though employees could sue their employers after being adversely affected by the harmful effects of UVR, this remedy does nothing to prevent the potentially fatal skin cancer. In any case, legal remedies involve delays and costs and it may also be intrinsic difficult to prove that the particular injury or illness was due to exposure to UVR in the workplace.
- 59 The wide variety of industries with outdoor workers or with workers who use artificial sources of UVR, means that it is unlikely for a single peak industry body to take the lead in defining a standard or managing the effective implementation of the ICNIRP Guidelines.

- 
- 60 There is no single peak body that could coordinate a uniform industry response, leading to different approaches being taken in different industries, and consequently the level of protection would be likely to be variable. Some industries may provide little or no additional protection and hence there is no certainty that risk levels from UVR exposure will change, similar to option 1.
- 61 The operation of a voluntary Standard, such as the NHMRC standard since 1989, has allowed the industry in most jurisdictions to self-regulate. While some industries have developed protection policies and measures, this is not universal and population rates of skin cancers, melanomas and cataracts are continuing to rise.

#### *Administration Costs*

- 62 Governments would have little administration costs, as industry would be self-regulating. However, Governments will have no control over exposure limits and this could be detrimental to the health and safety of occupationally exposed persons.

### **Option 3 – Adopt the ICNIRP Guidelines as the Australian standard**

- 63 This would involve the referencing and/or reproduction of the ICNIRP Guidelines as the Australian standard and jurisdictions implementing it as a mandatory standard.

#### *Option 3 - Benefits*

- 64 The ICNIRP Guidelines are easily obtained (free of charge from the ICNIRP website).
- 65 As the ICNIRP Guidelines contain the same exposure limits as the NHMRC standard (under option 1) and the proposed ARPANSA standard (under option 4), the industry would be aware of the measures required.

#### *Option 3- Costs*

##### *Compliance Costs*

- 66 The ICNIRP Guidelines do not include any risk management approach to deal with solar UVR exposure to outdoor workers. They rely on compliance with the limits, which is impractical for outdoor workers. If the ICNIRP limits were enforced for solar UVR exposure, the cost of measurement could be expected to be around \$50/worker for over 600,000 outdoor workers, or \$30m, should measurement be required to determine compliance. Given the variability of solar UVR, it is likely that measurement would need to take place more than once, leading to the expectation that costs for this component could exceed \$100m for outdoor workers.
- 67 If the limits were not enforced there is no mechanism to manage the risks of exposure to solar UVR for outdoor workers in the ICNIRP Guidelines. Hence the levels of melanoma, skin cancers and cataract in particular could be expected to continue to increase at current rates (6-7% per year for melanoma, and doubling of cataract medical costs by 2020).

#### *Administration Costs*

- 68 ICNIRP Guidelines are written in language not conducive to their legal adoption as mandatory limits. Even if the ICNIRP Guidelines were referenced or reproduced as an Australian standard and the regulatory agency in every jurisdiction legislated to make that standard mandatory, words in the ICNIRP Guidelines, such as, ‘*guidelines*’ and ‘*should not exceed*’ could confuse users into thinking that the limits are not mandatory.

This could make compliance monitoring and enforcement difficult compared to the implementation of an ARPANSA Standard (see option 4).

- 69 Governments are likely to have cost implications depending on the framework that each government has or establishes to monitor or enforce compliance with a mandatory standard.

#### **Option 4 – Implement an ARPANSA standard**

- 70 ARPANSA has reviewed the NHMRC standard and has developed a draft *Radiation Protection Standard on Occupational Exposure to Ultraviolet Radiation*. The review concluded that there was no need to change the NHMRC limits but found that the voluntary nature of the NHMRC standard was unsatisfactory. The earlier draft ARPANSA standard addressed this problem by making compliance with the exposure limits mandatory for both artificial and solar sources of UVR by using the word ‘*must*’ instead of word, ‘*should*’ in the Standard. Following consultation, the draft has been revised in regard to solar UVR exposure of outdoor workers. For outdoor workers, a risk management process and control prioritization process are employed to reduce employee exposure to solar UVR as much as possible. Monitoring and measuring exposure levels for outdoor workers was never intended due to its impracticality and it is now much clearer that measurement is not required.
- 71 As a result of these changes, this revised Standard has considerably reduced regulatory and cost impacts from the first draft of the Standard. Many employers will have already implemented many of the requirements covering outdoor workers and so there will be little in the way of additional costs for those employers.
- 72 In comparing the approach taken with overseas control models, the draft standard has parallels with the latest EU Directive on Optical Radiation, although both were arrived at independently, in that in the EU Directive UVR exposures to artificial sources of UVR are covered by a mandatory exposure limit while exposures to UVR from the sun, an uncontrolled source, are left to the individual member states of the EU to decide on.
- 73 The latest draft of the standard went out for a second round of public comment in late 2005 and underwent only minor revision after receiving mostly favourable comments, indicating that the amendments to the draft had resolved most of the earlier concerns.

#### **Option 4 - Benefits**

- 74 As mentioned previously, cancer costs an estimated \$2 billion in direct health system costs (6 per cent of total) and skin cancer is the most expensive, with annual costs in excess of \$300 million. Although skin cancer costs from occupational exposure to UVR is only a small part of the total costs, even a small improvement in compliance by employers will have significant effects in reducing the total health costs of skin cancer to the Australian community.
- 75 Quantitative estimates of the benefits can be obtained in terms of the cost saved by avoiding disease and overexposure incidents, as described below.
- 76 This section provides an estimate of the current costs of skin cancers that are likely to be caused by occupational exposure to ultraviolet radiation in Australia. Table 8 below shows the estimated total number of skin cancers in outdoor workers in 2002 (caused by any exposure – not just occupational) as well as the health costs.

**Table 8 Numbers of skin cancers in outdoor workers and costs in 2002**

Type of skin cancer	Estimated number of cancers in outdoor workers	Health costs
Basal cell carcinoma	18,065	\$29.5m
Squamous cell carcinoma	8,327	
Melanoma	582	\$8.3m

Source: Figures based on comments on draft cost-benefit analysis from Professor Bruce Armstrong. Figures assume outdoor workers have same sex distribution as whole of population. Costs are based on AIHW 2003.

- 77 The number of skin cancers in outdoor workers estimated to be caused by occupational exposure is lower. These are estimated roughly at 16% for BCC, 40% for SCC and 0% for melanoma (Armstrong in Hill et al 2004). It is recognised that there is a great deal of uncertainty associated with these estimates. However, on this basis the number of NMSCs in outdoor workers caused by occupational exposure is around 6,200 per year. The health cost of the 6,200 NMSCs per year is in the order of \$7m per year if based on the AIHW estimates. It should be noted that this is the share of total costs that can be attributed to occupational exposure.
- 78 There may also be some deaths due to NMSCs caused by occupational exposure. There is considerable uncertainty about the number of deaths. Based on the information available on the annual number of NMSC cases and deaths, a very rough range for mortality from NMSC is between 0.01% and 0.12%. This would suggest between 0.75 and 7 'statistical' deaths annually from occupational exposure. In order to estimate the benefit of reducing the probability of death from NMSCs caused by occupational UV exposure, an estimate of the value of a 'statistical life' is required. Estimates of the value of life differ widely, for example, with US estimates ranging from \$1m to \$15m. A recent Australian study estimated the willingness to pay for avoiding an immediate death of a healthy individual in middle age at \$2.5m (Abelson 2003). Using this estimate the benefit of reducing the probability of death from NMSCs resulting from occupational exposure could be valued at between \$2m and \$18m per year. However, these benefits will not accrue in the short term. Avoided NMSC cases and deaths would not arise for around 20 years, due to the latency period for NMSCs. The net present value (NPV) of these benefits over a ten year period (delayed by 20 years) is estimated at \$5m-\$48m.
- 79 The medical cost of melanoma related to outdoor workers has been estimated by Armstrong (2004) at \$8.3m per year, based on AIHW information. Only a small percentage of these are likely to be saved through protection programs, as melanoma is not thought to be strongly related to occupational exposure (Armstrong 2004). If this was 5-10%, then after a 20 year latency, the 10 year NPV would be \$0.8m-\$1.6m. In addition to the medical cost of melanoma there is the cost of deaths due to the disease. There are over 1300 deaths from melanoma per year. It is estimated (Armstrong & Kricker 1993) that for Europe 80% of melanoma is due to sun exposure and for Oceania, 94%. Assuming that the percentage is in this range, that 10% may be related to occupation, a 10% improvement may be achieved by protection measures and that the cost of a life is \$2.5m, then the 10 year NPV after a 20 year latency is \$49m-\$58m.

- It should be noted that this could be an underestimate as melanoma deaths are currently increasing at 6-7% per year.
- 80 The cost of 160,000 cases of cataract/year is \$327m, and it has been estimated that 10% of these are related to UVR exposure. Assuming that protection programs could reduce this by 10% after 20 years, and that indirect costs are twice the direct costs the 10 year NPV after 20 year latency is \$19.1m.
- 81 Similarly for pterygia, if the cost per year is \$8.3m, 50% of pterygia are due to UVR, protection programs can reduce this by 10%, and indirect costs are twice the direct costs, then the 10 year NPV after a 20 year latency would be \$3.1m.
- 82 Benign sun-related skin damage may also have important impacts on self-image and quality of life, even though there may not be substantial economic costs involved. Costs could be estimated, for example by medical visits to remove keratoses. Assuming that 10% of over 600,000 outdoor workers require such treatment once every 5 years, the cost of a treatment is \$50 and that the measures in the Standard would reduce the number of treatments by 10%, the cost over 10 years (NPV) would be \$4.7m.
- 83 Even the effect of protection programs on sunburn injuries could generate significant savings. For example if 5% of 623,000 outdoor workers take one day off work per year due to sunburn, and assuming protection programs could be expected to significantly reduce this, to say 0.5%, and assuming a typical lost production cost of \$300 per worker, then the 10 year NPV would be \$63m.
- 84 For artificial sources of UVR, benefits include protection measures reducing the number of overexposure incidents and injuries.
- 85 For example, in the last 3 years there have been 6 incidents with transilluminators arising in WA and the Commonwealth, jurisdictions that currently regulate specified UVR devices. This could indicate about 16 such incidents are likely across Australia per year. It is estimated that the cost of such an incident (including medical costs, lost production and regulatory investigation costs) is of the order of \$2000-\$4000 leading to a 10 year NPV of \$0.24m - \$0.48m. It would be expected that implementation of protection programs as in the Standard would prevent such incidents.
- 86 A report by the Monash University Accident Research Centre (1998) discusses the number of hospital Emergency Department (ED) visits and GP visits for eye injuries in Victoria, including from welding. Leaving aside those welding injuries from foreign bodies, those related to occupational exposure and potentially UVR related were 56-70% of the 310 ED visits and 23-29% of the 22 GP visits in Victoria. This could indicate a level of 900-1100 ED visits and 25-45 GP visits across Australia. In addition, 4% of ED visits result in hospital admissions. For the purposes of estimation, using 1 day of lost time (\$300) for ED visits, \$2300 for ED treatment and follow up, and 0.5 days, \$50 for GP visit and \$50 for pharmaceuticals, and 2 days lost time and \$4000 cost for admissions a rough costing is \$18.8m – \$23.3m (10 year NPV).
- 87 Significant savings on unquantifiable indirect costs, such as the social and psychological costs of illness and death, self-image, quality of life etc, have not been included, other than for eye injuries (cataract and pterygia) where some information was available.

- 
- 88 If the figure of 80 workers compensation cases in 2001 is typical then savings from the implementation of protection programs is also to be expected.
- 89 Further unquantifiable benefits include that employers in industries that use equipment or devices that emit UVR will have access to an Australian standard with safe exposure limits and will have ARPANSA as a reference point for information, advice and clarification on the exposure limit values.
- 90 Employees will feel confident that mandatory exposure limit standards are being applied and enforced to protect them from the harmful effects of UVR.
- 91 Governments can enforce compliance through the combined application of the ARPANSA standard and the legislative underpinning of the standard in each jurisdiction's radiation protection legislation.
- 92 Governments can maintain the standard through ARPANSA's Radiation Health Committee processes to ensure that the standard is updated to reflect current international guidelines and scientific research.

#### ***Option 4 – Costs***

##### ***Compliance Costs***

- 93 Employers will incur compliance costs to measure or determine exposure values for artificial sources of UVR and provide shielding and other means to ensure that their employees are not exposed beyond the limits specified in the standard. It was never intended and it is not required that employers of outdoor workers are required to measure the exposure of their outdoor workers to solar UVR. Compliance costs arise from the implementation of protection programs including development of protection plans, and provision of protective equipment.
- 94 The estimated total number of outdoor workers was shown in Table 5 above. For the purpose of generating an estimate of the order of magnitude of possible costs, it is assumed that around 60% of employees working for large employers in these industries would be outdoor workers. The average large employee is estimated to have 80 employees of which around 50 are outdoor workers (spread over 4 sites). For small employers it is assumed that all workers would be outdoor workers (as the average size small employer is estimated to have 3-5 employees). It is assumed that 90% of workers are not currently adequately protected from the sun. This estimate is expected to be conservative given the results of the Queensland audit. These assumptions lead to an estimated total of 180,000 unprotected outdoor workers employed by large employers, and 450,000 unprotected outdoor workers employed by small employers.
- 95 Compliance costs for employers of outdoor workers are incurred in developing policy and protection plans, involving and informing employees, providing clothing and hats, and providing sunscreen. The estimates of these costs are based on hypothetical case studies. The costs for individual employers may vary substantially from these estimates, given the wide range of types of employers affected and the size of companies within each industry. The estimates were developed by Thinc Communications in 2004, as part of a cost benefit analysis developed for NSW Department of Environment and Conservation and ARPANSA, after discussion with a small number of companies in order to generate an estimate for the potential order of magnitude of the total costs for industry.

- 
- 96 The cost of developing policy and protection plans is estimated at 1 week of an OH&S manager's time (@ \$500/day). This would only be a cost in the first year. For a small employer the cost is estimated at 1 day in the first year. As it is proposed to publish generic policy/plans separate from the Standard to assist employers, these costs are likely to be halved, i.e. \$1250 for large employer (LE) and \$250 for small employer (SE) in the first year.
- 97 The cost of involving and informing employees is estimated at 0.5 days for 4 site managers at \$500/day and 0.25 days for 50 workers at \$300/day = \$4750 (1<sup>st</sup> year only) and 10% of this per year for years 2-10. For a small employer the cost is estimated at 0.25 days for 3-5 workers at \$300/day = \$225-375 (1<sup>st</sup> year) and 10% (years 2-10).
- 98 The cost of providing hats and clothing for UVR protection is estimated at \$25 + \$60 (LE in 1<sup>st</sup> year) and 10% (years 2-10). For a small employer the cost is estimated at \$25 + \$60 for 3-5 workers = \$255-\$425 (1<sup>st</sup> year) and 10% (years 2-10).
- 99 The cost of providing sunscreen for a large employer is estimated at 4 x 2.5 litre (@\$70 ea) at 4 sites = \$1120/year. For a small employer it is estimated at 2.5 litre/ year = \$70/year.
- 100 Hence the overall cost in NPV terms over 10 years is Approx \$24500 (LE) = \$490/worker and \$1570-2100 (SE) = \$420-\$520/worker.
- 101 This enables the total cost over the population of outdoor workers to be estimated as:
- LE costs = 180,000 employees x \$490 = \$87m (10 year NPV)
  - SE costs = 450,000 employees x \$420-\$520 = \$187m-232m (10 year NPV)
- 102 Given that it is estimated that 70% of large employers and 30% of small employers already have UVR protection measures similar to the requirements of the Standard in place, compliance costs of implementation for outdoor workers are estimated at \$158m - \$198m (NPV over 10 years) or \$16m - \$19m per year.
- 103 For artificial sources of UVR, compliance costs consist of providing screens and signs for equipment, and clothing, shields and/or eyewear for workers.
- 104 There may also be compliance costs in some cases to modify equipment to address any faults identified. All employers would need to measure worker exposure to determine whether they comply with the standard. Those who don't comply would need to implement administrative, workplace and personal protection measures ensure they meet the exposure limits in future.
- 105 The costs of measuring exposure are estimated at around \$50 per worker. For workplaces that do not currently comply with the exposure limits there would be additional costs to assess risks, develop and appropriate policy and implement protective measures (eg. screening, face shields, protective eyewear, access signs). In the absence of any information on compliance with the standard it is assumed that around 30% of workplaces may not be complying. It is difficult to estimate the likely costs of measures, given that some of the equipment is in a medical setting and some in large businesses (eg industrial) or small businesses (eg solaria). For the purpose of estimating the order of magnitude of compliance costs, the average costs of protective measures are estimated at \$100 per piece of apparatus (screens & signs) and \$100 per worker (clothing, shields and/or eyewear) in the first year and 10% thereafter.
-

- 106 Based on these assumptions, the total costs to employers for administration and compliance with exposure limits is estimated at \$3.5m (NPV over 10 years).
- 107 Given that welding is used widely throughout the community, it is difficult to develop robust estimates of the numbers of workplaces, equipment and individuals affected. It is even more difficult to assess the likely level of compliance with the proposed exposure limits. The protective measures required are likely to be similar to those for other artificial sources such as screens, protective clothing and eyewear. In order to provide an order of magnitude estimate, it is assumed for the welding and printing industries around 30% of activity would not comply with the standard and that the costs of compliance would be around \$100 per worker in the first year and 10% thereafter. The total costs would therefore be around \$4m (NPV over 10 years).

#### *Administrative Costs*

- 108 As the proposed ARPANSA standard was developed by the Radiation Health Committee with representatives from all States and Territories, it is expected each regulatory agency in the States and Territories will adopt the standard into its regulatory framework. This is likely to have cost implications for these agencies, depending on the framework that each agency has or establishes to monitor or enforce compliance with the standard. Amending legislation (if required) may cost up to \$100,000 per jurisdiction, but several jurisdictions either regulate or have provision to now, so the maximum one-off cost would be less than \$500,000.

#### *Summary of Costs and Benefits of Option 4*

<b>Costs</b>	<b>Benefits from reduced disease and incidents (10 year NPV)</b>
<i>Compliance Costs - Outdoor workers</i>	<i>Outdoor workers</i>
Develop Policy            \$1250 (LE) \$250 (SE)	NMSC                        \$5m - 48 m
Involve/inform employees \$4750 (yr 1) + 10%/yr (LE) \$225-375 (yr 1) + 10%/yr (SE)	Melanoma                \$49.8m – 59.6m
Clothing & Hats            \$4250 (yr 1) + 10%/yr (LE) \$255-425 (yr 1) + 10%/yr (SE)	Cataract                    \$19.1m
Sunscreen                    \$1120/yr (LE) \$70/yr (SE)	Pterygia                    \$3.9m
Total Costs LE outdoor workers (10yr NPV) = \$88m x 30% with no existing program = \$26	Sunburn                    \$63m
Total Costs SE outdoor workers (10yr NPV) = \$189m-\$234m x 70% with no existing program = \$132m - \$164m	Keratoses                 \$4.7m
<i>Compliance Costs – Artificial Sources</i>	<i>Artificial Sources of UVR</i>
Welding & Printing    \$4m (10yr NPV)	Incident reduction        \$0.24m - \$0.48m
Other                         \$3.5m (10 yr NPV)	Welding eye injuries      \$19m - \$23.8m
	<i>Other unquantified benefits</i>
	Reduction in workers compensation claims, savings on indirect costs, e.g. social and psychological costs of illness/death, loss of self-image, loss of quality of life

<b>Costs</b>	<b>Benefits from reduced disease and incidents (10 year NPV)</b>
<p><i>Administration Costs</i></p> <p>Amending legislation up to \$0.5m (1<sup>st</sup> yr only)</p> <p>Audit/Inspection (artificial sources) \$4m (10 yr NPV)</p> <p>Audit/Inspection (outdoor workers) \$0.5m/yr</p>	
<b>TOTAL Costs \$17.7m - \$20.7m/year</b>	<b>TOTAL Benefits exceed \$17m - \$22m/year</b>

109 Hence there is a positive net benefit from adoption of the Standard.

**Summary of Costs and Benefits**

	<b>Option 1 (Do nothing)</b>	<b>Option 2 (Self-Regulation)</b>	<b>Option 3 (Adopt ICNIRP Guidelines)</b>	<b>Option 4 (Adopt ARPANSA Standard)</b>
<b>COSTS</b>				
<i>Compliance</i>	Current non-uniform approach would continue to generate unquantifiable costs	Lack of a peak body would mean that current non-uniform approach would continue to generate unquantifiable costs	Up to about \$100m if measurement is required for outdoor workers	Total quantifiable compliance and administration costs for artificial sources and outdoor workers of the order of \$17.7m - \$20.7m per year See summary table for option 4.
<i>Administration</i>	None	None	Costs of enforcement likely to be complicated by wording of the Guidelines	
Enforcement	None	None		
Legislative changes				
<b>TOTAL COSTS</b>	Limited Costs			\$17.7m-\$20.7m/yr
<b>BENEFITS</b>				
Health gains	Significant health cost as current rates of increase in skin cancer, melanoma, cataract etc likely to continue due to having no mechanism to manage exposure of outdoor workers.	Significant health cost as current rates of increase in skin cancer, melanoma, cataract etc likely to continue, as situation that has existed with NHMRC standard would continue.	Significant health cost as current rates of increase in skin cancer, melanoma, cataract etc likely to continue due to having no mechanism to manage exposure of outdoor workers.	Total quantifiable benefits of the order of \$17m - \$22m per year, in addition to a range of unquantifiable reduction in indirect costs, eg social and psychological costs of illness/death, loss of self-image, loss of quality of life.

	<b>Option 1</b> (Do nothing)	<b>Option 2</b> (Self-Regulation)	<b>Option 3</b> (Adopt ICNIRP Guidelines)	<b>Option 4</b> (Adopt ARPANSA Standard)
	Some unquantifiable reduced costs from industry having flexibility to adopt approaches that suit their needs	Some unquantifiable reduced costs from industry having flexibility to adopt approaches that suit their needs		
<b>TOTAL BENEFITS</b>	Significant negative	Significant negative		In excess of \$17m-\$22m/yr
<b>NET BENEFIT</b>	<b>Significant net negative</b>	<b>Significant net negative</b>	<b>Significant net negative</b>	<b>Net Positive</b>

## Consultation

110 The proposed standard was developed by a working group of the Radiation Health Committee. The Radiation Health Committee includes representatives from all Commonwealth, State and Territory radiation protection regulators.

111 The draft standard was advertised on 18 June 2003 for a period of public comment until 15 August 2003. Copies of the proposed standard were also available on the ARPANSA web site at [www.arpansa.gov.au](http://www.arpansa.gov.au). The following organisations were advised of the availability of the proposed ARPANSA standard and Regulatory Impact Statement and their comments requested:

- National Occupational Health & Safety Commission
- Comcare
- ACT Cancer Society
- ACT Workcover
- Queensland Cancer Fund
- Statewide Health Promotion Unit, Queensland Health
- Division of Workplace Health & Safety, Queensland Dept of Industrial Relations
- Cancer Foundation of Western Australia
- Department of Mineral And Petroleum Industries
- University of Western Australia, Safety & Health Office
- Anti-Cancer Foundation, SA
- Workplace Services, SA Attorney-General's Department
- Local Government Association Workers' Compensation Scheme, SA
- SA Workcover Corporation
- NSW Cancer Council
- Workcover NSW
- Anti-Cancer Council of Victoria
- Senior HR Consultant, Health & Rehabilitation, Dept of Education, Tasmania
- Cancer Council of Tasmania
- Workplace Standards Tasmania
- Cancer Council of the Northern Territory
- Work Health NT
- Australasian College of Physical Scientists and Engineers in Medicine

- CSIRO
- Australasian Radiation Protection Society
- Ultraviolet products P/L
- Australasian College of Dermatologists

112 Arising from the first round of consultation were several key issues.

- Firstly, the consultation draft of the Standard included mandatory exposure limits for outdoor workers. This raised concern that employers would be required to measure solar UVR levels to determine compliance with the Standard. This was not intended and would have been extremely costly. As a result the Standard was amended to include limits only for artificial sources, while for outdoor workers a UV protection plan is required.
- Concern about the cost of implementing the Standard and that the Consultation RIS had not provided enough quantitative information. A cost-benefit analysis examining aspects of the Standard and the Consultation RIS and commenting on options was prepared by Thinc Communications. It was later reviewed by two leading epidemiologists. This work and comments from the reviews have been used in preparing this final RIS, as appropriate.

113 The changes made to the Standard have been reflected in the cost-benefit analysis of the options.

114 A second round of consultation was also undertaken, wherein those organisations that made submissions on the earlier draft were requested to make further comment along with a range of key interest groups and experts. They were asked to comment on whether there were still concerns after the changes in response to submissions.

115 Second round submissions on the Standard were received from 8 organisations (WorkCover NSW, NSW Health Department, Workplace Health and Safety Qld, Sunsmart Program CCV, Southern Australian Asphalt Pavement Association, University of NSW, NSW Dept of Environment and Conservation). In most cases responses were positive with minor editorial changes in wording and structure recommended.

## Conclusion and Recommendation

116 Option 4 is the only option producing a positive net benefit and is therefore recommended. The following considerations also apply regarding each of the options reviewed.

117 Option 1 does not meet the objectives and NHMRC has decided to discontinue its RHS publications and the current NHMRC standard will not be reviewed or updated in future to be in accord with any change to international guidelines or new scientific findings.

118 Option 2 is not preferred for the following reasons:

- (a) Self-regulation will not satisfy concerns of occupationally exposed persons that their health and safety has been adequately addressed by their employers. This is exemplified by the current lack of compliance to the voluntary NHMRC standard as shown in the Queensland study referred to above.

- (b) The potential for occupational exposure to unsafe levels of UVR is neither a low risk event nor of low significance. This is illustrated by the skin cancer statistics and health cost burden of skin cancer described above.
  - (c) There is little evidence that the industry has the structure to organise itself for self regulation and keep up with international guidelines or scientific findings.
  - (d) Governments cannot fully divest their responsibility to monitor compliance and take action to remedy non-compliance in matters concerning radiation health and safety. This view is supported by the fact that ICNIRP recommendations on non-ionizing radiation in general and World Health Organisation (WHO) recommendations on solar UVR in particular refer to governments' roles to facilitate the establishment of standards and educational programs.
  - (e) In the area of UVR, ICNIRP and WHO play an important role in recommending measures to protect people and environment from the harmful effects of UVR. The WHO recommends the prevention of the ill effects of excessive exposure to UVR through protective measures.<sup>23</sup> From the Queensland study mentioned above, it is clear that the voluntary NHMRC standard has not been effective to optimise preventive measures, at least in the construction industry. It is felt that industry self regulation is not likely to improve the situation.
- 119 Option 3 is not suitable as the ICNIRP Guidelines are not mandatory and are in fact recommendations meant to be used by Governments to formulate and establish standards in their own countries. The voluntary nature of the ICNIRP Guidelines makes it unsuitable to deal with the compliance problem.
- 120 The benefits of Option 4 outweigh its costs, and this is not the case for the other options examined.
- 121 Option 4 also enables ARPANSA to be a reference point for information, advice and clarification. ARPANSA has the appropriate scientific resources and international liaison framework in place to ensure that the standard is updated to reflect current international guidelines and scientific research. For example, an Annex has been produced detailing practical and cost-effective means of complying with the standard. The proposed Annex is published as Annex 3 of the proposed ARPANSA standard.
- 122 It is recommended that the proposed ARPANSA Radiation Protection Standard on Occupational Exposure to Ultraviolet Radiation (Option 4) be implemented as a standard in ARPANSA's Radiation Protection Series and included in the National Directory for Radiation Protection.

## Implementation and Review

- 123 The proposed standard will be published by ARPANSA under its Radiation Protection Series. The standard will be reviewed by ARPANSA's Radiation Health Committee within 10 years of its commencement to ensure it is still relevant to radiation protection needs. Earlier review would be undertaken if there are problems in the implementation of the standard, if international or national radiation protection objectives change or if there is new information from international research.

---

<sup>23</sup> *Protection Against Exposure to Ultraviolet Radiation (WHO/EHG/95.17): Basic measures needed to protect against the adverse effects of UV exposure*, Joint publication by WHO, UNEP, Geneva, 1995.

124 After publication, the standard will be proposed for incorporation into the National Directory for Radiation Protection, edition 2 of which is now being prepared by ARPANSA. In August 1999, the Australian Health Ministers' Conference endorsed the National Directory as the mechanism for implementing national standards and codes of practice in radiation protection. When the standard is incorporated into the National Directory, regulators in the States and Territories must adopt the standard into their regulatory frameworks, paving the way for the proposed ARPANSA standard to become a common national standard in Australia.

## References

*Cancer in Australia 1998: Incidence and mortality data for 1998*, (Cancer Series Number 17), Australian Institute of Health and Welfare and Australasian Association of Cancer Registries, Canberra, October 2001.

*Environmental Health Criteria 160, Health and environmental effects of ultraviolet radiation*, UNEP/ICNIRP/WHO, Geneva, 1994.

*Exposure to Ultraviolet Radiation in the Construction Industry – Audit Report*, Division of Workplace Health and Safety, Queensland, March 2002.

*Guidelines on limits of exposure to ultraviolet radiation of wavelengths between 180 nm and 400 nm (incoherent radiation)*, IRPA/INIRC 1985, Health Physics 1985; 49(2): 331-340.

*Guidelines on UV Radiation Exposure Limits*, International Commission on Non-Ionizing Radiation Protection, Health Physics 1996.

*Measured Solar Ultraviolet Radiation Exposures of Outdoor Workers in Queensland in the Building and Construction Industry*. Peter Gies and Jill Wright. Photochem. Photobiol., 78:342-348, 2003.

*Occupational standard for exposure to ultraviolet radiation*, National Health and Medical Research Council 1989, Radiation Health Series No.29. Canberra: NHMRC.

*Principles and guidelines for national Standard Setting and Regulatory Action by Ministerial Councils and Standard-Setting Bodies*, Council of Australian Governments, November 1997.

*Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Councils and Standards-Setting Bodies*, Council of Australian Governments (COAG) Committee on Regulatory Reform, November 1997.

*Proposed change to the IRPA 1985 guidelines on limits of exposure to ultraviolet radiation*, IRPA/INIRC 1989, Health Physics 1989; 56(6): 971-972.

*Recent and Future Activities of the ICNIRP*, JH Bernhardt and R Matthes 1997, Radiation Protection Dosimetry, 72; pp. 167-176.

*Resource Guide for UVR Protective Products*, ARPANSA, 1999.

*Clear Insight: The Economic Impact and Cost of Vision Loss in Australia*. Eye Research Australia, 2004.

*Sunsmart 2000, Sun Protection Policies and Practices for Outdoor Workers, 1998 Sunsmart Workplace Survey*.

*Unintentional Adult Eye Injuries in Victoria*, AL Imberger, AE Altmann & W Watson, Monash University Accident Research Centre, Report No. 137, May 1998.

Wlodarczyk J, et al. Pterygium in Australia: a cost of illness study. *Clin Experiment Ophthalmol* 2001; 29: 370-375.

Thinc Communications, Report to the New South Wales Department of Environment and Conservation, *Final Cost-benefit Analysis of Draft Radiation Protection Standard for Occupational Exposure to Ultraviolet Radiation* (April 2004)

---

## Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ICNIRP	International Commission on Non-Ionizing Radiation Protection
INIRC	International Non-Ionizing Radiation Committee of the International Radiation Protection Association
IRPA	International Radiation Protection Association
NHMRC	National Health and Medical Research Council
NOHSC	National Occupational Health and Safety Commission
NRPB	National Radiological Protection Board (UK)
OH&S	occupational health and safety
RHS	Radiation Health Series (published by the NHMRC)
RPS	Radiation Protection Series (published by ARPANSA)
UNEP	United Nations Environment Programme
UPF	Ultraviolet Protection Factor
UV	Ultraviolet
UVA and UVB	UVR is classified as UVA, UVB and UVC. UVB and UVC are potentially the most dangerous to humans. Ozone and oxygen in the atmosphere absorb all the UVC and most of the UVB before it reaches the earth's surface. UVB is more damaging to the skin and eyes than UVA, however, both UVB and UVA are implicated as causes of skin cancers and some eye disorders.
UVR	ultraviolet radiation
WHO	World Health Organisation

**Attachment 1 – Current framework for managing occupational exposure to UV**

Jurisdiction	Workplace legislation	Policies/guidance/initiatives relating to occupational exposure to UV
Commonwealth	National Occupational Health and Safety (Commission) Act 1985 [repealed 15 Nov 05]  Australian Workplace Safety Standards Act 2005  Occupational Health and Safety (Commonwealth Employment) Act 1991	<ul style="list-style-type: none"> <li>- NHMRC's <i>Occupational Standard for Exposure to Ultraviolet Radiation 1989</i></li> <li>- Ruling by the Federal Court allowing outdoor workers able to claim sunscreen, hats and sunglasses as legitimate work expenses</li> <li>- ARPANSA measures daily solar UVR and distributes information</li> <li>- Office of the Australian Safety and Compensation Council – <i>Fact Sheet on Skin Cancer</i></li> <li>- Office of the Australian Safety and Compensation Council - <i>OHS Practical Solutions Database</i></li> <li>- <i>Guidance Note for the Protection of Workers from Ultraviolet Radiation in Sunlight (NOHSC 3012) 1991</i>]Cancer Council of Aust - <i>Position Statement – sun protection in the workplace</i></li> </ul>
New South Wales	Occupational Health and Safety Act 2000; Occupational Health and Safety Regulations 2001  (regulation covers risk control measures for UV at welding sites)	Workcover NSW's: <ul style="list-style-type: none"> <li>- Guide for Employers/Guide for Employees <i>Skin Cancer and outdoor workers</i></li> <li>- Code/Manuals for excavation, supervisors in the construction industry, and the hospitality industry</li> <li>- Wine industry code of practice</li> <li>- Section on sun safety at work in rural safety magazine July 2003</li> <li>- <i>A Guide To Implementing Best Practice In Sun Protection In Local Government</i></li> </ul> NSW Cancer Council's: <ul style="list-style-type: none"> <li>- <i>Guide to implementing better practice in sun protection in the workplace</i></li> <li>- <i>A workplace sun protection policy guide</i></li> <li>- <i>Saving our skins video and workplace policy guide (1997)</i></li> <li>- Workplace Consultancy Service</li> <li>- <i>UV Risk Reduction: A Planning Guide for Secondary School Communities</i></li> <li>- <i>Sun Safety At Work - Policy on Protection from Ultraviolet Radiation for Outdoor Workers</i></li> <li>- <i>Webpage - Sun Protection in the Workplace</i></li> </ul>
Queensland	Workplace Health and Safety Act 1995	<ul style="list-style-type: none"> <li>- Division's SafetyLink <i>Guidance Controlling excessive exposure to UV</i> October 2001 [can't locate]</li> </ul>

	Workplace Health and Safety Regulations 1997	<ul style="list-style-type: none"> <li>- Division carried out an audit of exposure in the construction industry in Sept – Nov 2001 [can't locate]</li> <li>- Qld Health – Website - Health Information on Sun Safety – Workplaces – Personal Protective Equipment</li> <li>- Qld Health Factsheet – <i>Ultraviolet Radiation</i></li> <li>- Qld DIR Website – <i>Sun Safety and Heat Stress</i></li> <li>- SunSmart Policy Guidelines - <i>Working towards a SunSmart Queensland</i></li> </ul>
Victoria	Occupational Health and Safety Act 2004	<ul style="list-style-type: none"> <li>- Blitz of the construction industry in early 2004 requiring development of appropriate UV protection policies</li> <li>- VIC Cancer Council, Worksafe Victoria and VicHealth's <i>Guide Working Outdoors: a skin cancer risk</i> December 2002</li> <li>- Free cancer checks offered during WorkSafe Week in October 2003 (Sunsmart, Workers Occ. Health Centre and Worksafe Victoria) October 2004</li> <li>- Victorian Trades Hall Council's Occupational Health and Safety Unit's online guidance and "UV risk assessment checklist"</li> <li>- Sunsmart survey of 100 major companies employing outdoor workers 2003</li> <li>- Sunsmart Information Sheet – <i>Sun Protection in the Workplace</i></li> <li>- <i>Saving our skins</i> – video Vic 1990</li> <li>- Worksafe Guidance Note: <i>Sun Protection for Construction and Other Outdoor Workers</i></li> <li>- Sunsmart Brochure : <i>UV Alert</i></li> <li>- Worksafe Victoria <i>The construction industry ultraviolet protection campaign 2003-2006</i></li> <li>- Worksafe Victoria press release – <i>WorkSafe turns up the heat on sun protection for workers</i> (Nov 2005)</li> </ul>
South Australia	Occupational Health, Safety and Welfare Act 1986; Occupational Health, Safety and Welfare Regulations 1995	<ul style="list-style-type: none"> <li>- SA Cancer Council &amp; SA Workcover's <i>Implementing a Sunsmart policy in the workplace</i></li> <li>- SA Cancer Council's Factsheet <i>Outdoor workers and the sun</i></li> <li>- SA Cancer Council talks and kits for employer groups</li> <li>- SA Cancer Council's factsheet <i>Ultraviolet Radiation</i></li> <li>- SA Cancer Council' brochure <i>Outdoor Workers and the Sun</i></li> </ul>
Tasmania	Industrial Relations Act 1984; Workplace Health and Safety Act 1995	<ul style="list-style-type: none"> <li>- Cancer Council Website – <i>Sun Protection in the Workplace</i> (includes references to various resources – brochures, information kits, posters, videos etc)</li> </ul>

Western Australia	Occupational Health and Safety Act 1984	<ul style="list-style-type: none"> <li>- Information distributed by Worksafe inspectors</li> <li>- Worksafe Press releases at beginning of summer highlighting duty of care to occupational groups</li> <li>- <i>WA Commission for Occupational Health and Safety – Code of Practice - Concrete and Masonry Cutting and Drilling</i></li> <li>- <i>Cancer Council of WA – Workplace presentations</i></li> <li>- <i>Cancer Council of WA - Health Business Project</i></li> <li>- <i>Worksafe Division – Educational Article – Working Safety in Hot Weather</i></li> </ul>
ACT	Occupational Health and Safety Act 1989	<ul style="list-style-type: none"> <li>- <i>ACT Cancer Council – a range of activities and resources under the General Cancer Early Detection and Prevention Program</i></li> </ul>
Northern Territory	Work Health Act; Work Health (Occupational Health and Safety) Regulations	<ul style="list-style-type: none"> <li>- NT Worksafe Bulletin “<i>Take Control – Exposure to non-ionising radiation</i>” WH17.05.05</li> </ul>

**Attachment 2 – Current framework for managing occupational exposure to artificial sources of UV**

Jurisdiction	Workplace legislation	Radiation Legislation	Regulatory Authority (occupational use of UV)	Policies/guidance
Commonwealth	National Occupational Health and Safety (Commission) Act 1985 <i>[repealed 15 Nov 05]</i>  Australian Workplace Safety Standards Act 2005	Australian Radiation Protection and Nuclear Safety Act 1998;  Regulations refer to 1989 NHMRC UV standard	ARPANSA	<ul style="list-style-type: none"> <li>- Australian Standards for:               <ul style="list-style-type: none"> <li>• Filters for eye protection against UVR –</li> <li>• AS/NZS 1338.2 (1992);</li> <li>• Determining intensity from germicidal ultraviolet lamps – AS/NZS 1807.23 (2000)</li> <li>• Solaria – AS/NZS 2635 (2002)</li> <li>• Laser Safety – AS 2211 (1991), AS 2397 (1993),</li> <li>• AS 4173 (1994),</li> <li>• AS/NZS 2211.9 (2002)</li> <li>• <i>AS/NZS 1336 (1997)</i></li> <li>• <i>Recommended practices for occupational eye protection - AS/NZS 1336</i></li> <li>• <i>Sunglasses - AS/NZS 1067 (2003)</i></li> </ul> </li> <li>- <i>Cancer Council of Aust - Position Statement - eye protection</i></li> <li>- <i>Cancer Council of Aust - Position Statement - Solariums</i></li> </ul>
New South Wales	Occupational Health and Safety Act 2000;  Occupational Health and Safety Regulations 2001  (regulation covers risk control)	Radiation Control Act 1990;  Radiation Control Regulation 1993	NSW Environment Protection Authority	<ul style="list-style-type: none"> <li>- Minimum safety standards for the safe use of ultraviolet radiation apparatus, February 1998 <i>[unable to locate]</i></li> <li>- <i>Cancer Council of NSW – Website – Suntans, Fake Tans and Solariums</i></li> <li>- <i>Cancer Council of NSW – Website – Sun Protection in the Workplace</i></li> </ul>

	measures for UV at welding sites)			<ul style="list-style-type: none"> <li>- NSW Health factsheet – <i>Solarium Safety</i></li> </ul>
Queensland	Workplace Health and Safety Act 1995 Workplace Health and Safety Regulations 1997	Radiation Safety Act 1999	Department of Industrial Relations, Division of Workplace Health and Safety	<ul style="list-style-type: none"> <li>- Plant Code of Practice 2005 – (1.22 Radiation Exposure) – covers Lasers, RF and UV</li> <li>- Foundry Industry Code of Practice 2004</li> <li>- Qld Dept of Industrial Relations – Advice on <i>Appliances for skin exposure to ultraviolet and infrared radiation</i></li> <li>- Qld Dept of Industrial Relations – <i>Guide for the Hairdressing, Nail and Beauty Industry</i></li> <li>- Qld Dept of Industrial Relations Website– Sun Safety and Heat Stress (Artificial sources of Ultraviolet Radiation)</li> <li>- SunSmart Policy Guidelines - <i>Working towards a SunSmart Queensland</i></li> <li>- Queensland Health Factsheet – <i>Artificial Tanning – Solariums and Sunbeds</i></li> </ul>
Victoria	Occupational Health and Safety Act 2004 Mineral Resources (Health and Safety) Regulations 1991 ( <i>refers to Australian Standard on filters for eye protection</i> ) [legislation revoked on 28 Oct 2002] -	Controls under Health Legislation; Health (Radiation Safety) Regulations 1994 (radiation legislation being developed)	No regulatory authority	<ul style="list-style-type: none"> <li>- VicHealth - <i>Solaria, saunas, flotation, tanks and gymnasiums - Client health information</i></li> <li>- VicHealth - Health guidelines for personal care and body art industries (<i>Solaria</i>)</li> <li>- VicHealth/SunSmart Brochure <i>Solariums – Fashion to Die For</i></li> <li>- Sunsmart Information Sheet - <i>Solariums</i></li> </ul>
South Australia	Occupational Health, Safety and Welfare Act 1986;	Radiation Protection and Control Act 1992	Environment Protection Authority	<ul style="list-style-type: none"> <li>- SA Cancer Council – <i>Fact sheet Solariums</i></li> </ul>

	Occupational Health, Safety and Welfare Regulations 1995			
Tasmania	Industrial Relations Act 1984; Workplace Health and Safety Act 1995	Radiation Control Act 1977	Workplace Standards Tasmania	
Western Australia	Occupational Health and Safety Act 1984	Radiation Safety Act 1975; Radiation Safety Regulations 1983 (refers to 1989 NHMRC UV standard)	Radiological Council of Western Australia	<ul style="list-style-type: none"> <li>- <i>WA Worksafe – Educational Article – Laser Hazards</i></li> <li>- <i>Cancer Council of WA – Use of Solaria</i></li> </ul>
ACT	Occupational Health and Safety Act 1989	Radiation Act 1983	ACT Workcover	<ul style="list-style-type: none"> <li>- <i>ACT Cancer Council Information Sheets – Solariums and UV Radiation and You</i></li> </ul>
Northern Territory	Work Health Act; Work Health (Occupational Health and Safety) Regulations ( <i>refers to Australian Standard on filters for eye protection against ultraviolet radiation</i> )		No regulatory authority	