

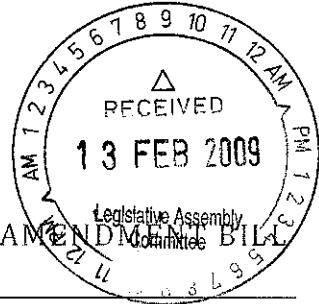
Submission 58

SUBMISSION TO THE EDUCATION AND HEALTH STANDING  
COMMITTEE

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INQUIRY INTO THE TOBACCO PRODUCTS CONTROL AMENDMENT BILL  
2008

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**UNIONSWA**



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## INTRODUCTION

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UnionsWA appreciates the opportunity to make a submission to this inquiry. In doing so, we note the positive intent of this legislation to limit the impact on non-smokers of secondary or side-stream smoke and particularly in relation to children in motor vehicles.

Any attempt to improve the health of our citizens and to reduce the potential cost burden on the state's health system should be supported. This bill will seek to do that and as such is supported.

However, there remain at least two examples of circumstances in WA workplaces where smoking is permitted and where employees are unwittingly subjected to the negative effects of side-stream smoke.

This includes one remaining area of the Burswood Casino and WA Prisons.

UnionsWA's submission will deal briefly with these two aspects of workplace smoking and urges the Committee to consider incorporating amendments into the bill that would ultimately remove smoking in all WA workplaces. We will not outline the health hazards in relation to passive smoking as these are no doubt well known to the Committee.

For the record, we note that Burswood has already implemented smoke free zones in most of its facilities and is to be applauded for that. Also, the circumstances facing WA Prisons are somewhat unique and whilst the aim of eventually achieving a non-smoking environment must be an objective this will need to be carried out with great care and sensitivity and in a staged approach over time and place.

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## BURSWOOD CASINO – INTERNATIONAL ROOM

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The International Room at the Burswood Casino remains one of the very few workplaces in WA where employees (and indeed other non-smoking patrons) are subjected to the

Prepared by D Robinson, Secretary, UnionsWA

hazards of smoking. Indeed, over the last few years, UnionsWA understands that the size of the venue has increased by around a third of its original area thus contributing even more to smoking health hazards.

Whilst attempts have been made to provide adequate ventilation in the venue, there can be no doubt that the only sensible way to prevent workplace injury and disease from the effects of smoking is to immediately implement a complete ban.

A report commissioned by Burswood, *“Burswood Casino Air Quality International Gaming Facilities Report”* and prepared by Lincolne Scott, who advised on the ventilation systems for the room, must be seriously questioned in terms of its recommendations.

Whilst at first glance it would appear that there are significant measures in place to try and protect employees and patrons, the reality is that there is only one measure that is known to work – the complete absence of second hand smoke.

The Lincolne Scott report has been critically evaluated by an international expert on second hand smoking Mr. James Repace MSc (whom I notice has tabled a submission to this inquiry) and his findings are sobering to say the least. I have appended a copy of his report to this submission for the information of the Committee.

It is instructive however, to reprint here the Executive Summary from the Repace report of 7 August 2005:

***“Executive Summary***

- The Lincolne Scott report is flawed because it does not specify the casino smoker density, ignores the guidance of the Australian Ventilation Engineering profession, establishes air quality goals which produce air pollution levels consistent with massively unacceptable health risks for casino workers, and fails to compare the efficacy of its proposed ventilation technology to actual “best practice”, i.e., smoking bans.*
- I estimate that the Lincolne Scott ventilation technology proposal to control SHS would expose Burswood Casino staff to risks exceeding U.S. occupational Safety and Health Significant Risk of Material Impairment of Health level by 4- to 15-fold.*

- *Reduction of the risk of secondhand smoke exposure for Burswood Casino Staff to acceptable levels would require tornado like air exchange rates greater than 120,000 air changes per hour, or more than 3400 times the highest rates proposed by Lincolne Scott in its ventilation technology scheme for the Burswood Casino.”*  
(Page 2)

The conclusions drawn by Repace in his report (pg 7) are indeed, very disturbing:

- Staff continue to be exposed to unacceptable risks of “morbidity and mortality from lung cancer, heart disease, as well as respiratory disease”;
- At the level of the typical measured data for the Burswood Casino, estimated excess risk due to SHS is very hazardous, at 10 times the Significant Risk level, and 10,000 times the *de minimis* or acceptable risk level;
- Casino staff’s estimated risk is significant, material, and substantial, and there is no reasonably practical means of mitigating, reducing, or avoiding the risk other than smoke-free working conditions;
- Smoking bans, rather than ventilation technology, constitute “best practice” for the control of secondhand smoke.

**Consistent with the findings of the Repace Report, UnionsWA calls for an immediate ban on smoking in the Burswood Casino’s International Room.**

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#### WA PRISONS

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Currently, inmates and visitors are permitted to smoke in the state’s prisons. It is also the case that the prison population smokes at a noticeably higher rate than the general community (estimated 70 – 80% in prison as against 21% in the general community). Prison Officers themselves seem to smoke at a similar level to that of the general community (21 – 23%) based on a survey of members of the WA Prison Officer Union.

This suggests an ongoing problem for the bulk of employees within custodial settings, who will be subject to side-stream or second hand smoke.

However, the circumstances facing staff within a prison are vastly different to those say in the International Room at Burswood Casino.

Amongst other things, the Prison is the 'home' of the inmates. Many inmates will rely on smoking as a means of some limited enjoyment and perhaps see it as a form of stress relief. To take this away immediately could, as the WA Prison Officers Union have submitted in a paper to the former Minister for Health, lead to *"prisoner self harm, aggression, boredom, increased use of other drugs, loss of management tool and a possible fire risk as illicit smoking may continue in an uncontrolled manner."*

There is no doubt, however, that the main problem for employees is *"with people smoking too close to doorways, in thoroughfares, in cells both during the day when unlocked and after a period of being locked (overnight), within enclosed spaces in buildings and within workshop environments. It was also noted that visitors also smoke close to main entrances of prisons while waiting to enter for visits."*

The WA Prison Officer's Union and UnionsWA support the following approach to managing smoking in WA Prisons and custodial institutions:

- 1. Prisons and grounds within the prison fence should immediately be designated as non smoking environments except for designated smoking areas.**
- 2. Children and babies should not be allowed in designated smoking areas.**
- 3. The long term plan should be to move towards smoke free units but in the short term there should be designated smoke free cells and possibly transition units where prisoners could be encouraged and assisted to give up smoking.**
- 4. Immediately implement a designated outdoor smoking area which is at least partly covered for each unit.**
- 5. Immediately implement a policy that prisoners would not be entitled to smoke in their cells during the day when they could go outside the unit into the smoking area.**
- 6. Prisoners would continue to be allowed to smoke in their cell while locked in overnight. However, suitable extractor fans should be fitted to cells which could be activated ½ hour prior to unlock.**
- 7. Immediately implement a smoking ban in Workshops. Where prisoners could leave the workshop, with permission, to go outside they should do this if they want to smoke. If the prisoner could not leave the Workshop then they would have to wait until the lunch break to leave the building to smoke. This would be possible in most prisons but for those where the prisoners could not leave the**

**Workshop or did not leave the Workshop for lunch then a small designated smoking area with ventilation could be provided.**

- 8. In areas like the SHU or Crisis Care Unit employees accept that there may be a special reason to allow smoking. Employees can, in most cases, self-select to staff these areas and as such this self selection, knowing it will be a smoking area, should be able to continue. It is important, however, if any area is designated a special smoking area within a prison that there be close liaison and discussion between prison management and local union representatives.**
- 9. Immediately implement a smoking ban for any area within 10 metres of any entrance or window of the prison. This would include the front gate when visitors were waiting to enter.**
- 10. Smoking should be banned immediately in the Visitors Area however this will require consultation with all unions covering the staff for such areas.**
- 11. Each institution to implement a Smoking Cessation Programme which would include a prison orientation process to inform prisoners of the Smoking Cessation Program's availability.**
- 12. A Smoking Cessation Programme must at a minimum address nutrition, physical activity, stress management and nicotine replacement therapy as well as education, recreation activities and group and individual counselling.**
- 13. Nicotine replacement patches and other cessation programme activities should also be supplied to staff on request, following appropriate medical assessment.**
- 14. The price of cigarettes/tobacco for prisoners should be increased to encourage reduced use and to help fund cessation programmes.**
- 15. Staff smoking should only be permitted outside in designated smoking areas.**

UnionsWA believes that a managed approach (which the above proposals go towards) is absolutely necessary to introducing smoking bans in WA prisons. It is essential that employees, visitors and other inmates are not subjected to undue risk as a result of smoking bans and it is our firm view that there must be a well managed and well implemented policy that acknowledges the concerns of employees who have to manage and control the behaviour of inmates.

There can be no doubt that this not ideal but it is strongly recommended as a pragmatic solution and the means by which robust and clear steps are initiated that will begin to change both the culture and health of inmates whilst also delivering a positive health outcome for employees.

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## CONCLUSION

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UnionsWA supports the thrust and intent of the Bill but notes that smoking workplaces are still prevalent in WA. We urge the Committee to incorporate the recommendations of our submission into its deliberations, noting that it must be an ultimate goal of all of us to ensure that, as a priority, workplaces are free from the hazards of side-stream smoke as much as beer gardens and al-fresco dining areas are.



# **A Critical Evaluation of Lincolne Scott's *Burswood Casino* *Air Quality International Gaming Facilities Report***

James Repace, MSc.

## **Repace Associates, Inc.**

*Secondhand Smoke Consultants*

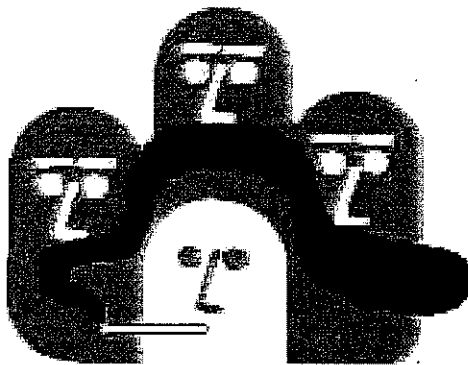
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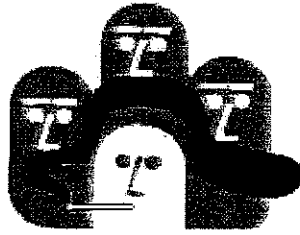
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August 7, 2005



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## **Critical Review of the Lincolne Scott Proposal for the Burswood Casino**

### **Executive Summary**

- The Lincolne Scott report is flawed because it does not specify the casino smoker density, ignores the guidance of the Australian Ventilation Engineering profession, establishes air quality goals which produce air pollution levels consistent with massively unacceptable health risks for casino workers, and fails to compare the efficacy of its proposed ventilation technology to actual "best practice", i.e., smoking bans.
- I estimate that the Lincolne Scott ventilation technology proposal to control SHS would expose Burswood Casino staff to risks exceeding U.S. Occupational Safety and Health Significant Risk of Material Impairment of Health level by 4- to 15-fold.
- Reduction of the risk of secondhand smoke exposure for Burswood Casino Staff to acceptable levels would require tornado-like air exchange rates greater than 120,000 air changes per hour, or more than 3400 times the highest rates proposed by Lincolne Scott in its ventilation technology scheme for the Burswood Casino.

## Introduction

I have been asked by Mr. Stephen Hall of the Australian Council on Smoking and Health to critically review an engineering report entitled "*Burswood Casino Air Quality International Gaming Facilities Report*", authored by the firm Lincolne Scott (LS). The Burswood Casino apparently has retained Lincolne Scott to upgrade its ventilation systems in the Casino's international gaming facilities (IGF). According to the LS Report, Burswood intends to expand its IGF and improve air quality in spaces with smoking (subject to government approval) according to "best practice" with respect to gaming environments. The LS proposal proposes to control the levels of secondhand smoke (SHS) (also known as environmental tobacco smoke, or ETS) using a combination of high volume outdoor air ventilation, directed airflows, air curtains, gaseous and electrostatically-enhanced particulate filtration, and maintenance procedures for removing deposited tobacco tars. My curriculum vitae may be viewed at [www.repace.com](http://www.repace.com) and a précis is included in Appendix B.

## Background

Secondhand smoke (SHS) is a known cause of lung cancer and heart disease mortality (CalEPA, 1997) and both recent and long-term SHS exposure have been associated with adult-onset asthma (Jaakkola et al., (2003). Casinos historically have been heavily polluted with tobacco smoke, and the casino industry has been resistant to smoke-free workplaces for its staff. Chronic exposure of staff to air pollution from smoking has led to illness and loss of livelihood, and has led to litigation in Australia and in the U.S. and the U.K. [Brook v. Burswood Casino (1999); Badillo v. American Tobacco et al. (1998); Avallone v. American Tobacco et al. (1998); Mullen et al. v. Treasure Chest (1999); Dunn v. Napoleon's Casino (2003)] as well as occupational health complaints [Trout et al., 1996; 1998]. Repace (2004) found that in a large casino in the U.S. State of Delaware, that a state-imposed smoking ban in the casino led to a decrease in levels of dangerous respirable particles (RSP) and carcinogens (PAH) by 96% and 98%, respectively. Although casino owners often justify their resistance to smoking bans by inducing fears of loss of tax revenue for the state and loss of workers' jobs, the smoking ban did not affect gaming revenues in this casino (Mandel et al., 2005). The prevalence of daily smoking among the West Australian adult population was 21% in 2001; an additional 4% of West Australian adults are occasional smokers, smoking less often than daily (DOHWA, 2005). By contrast, the same statistics for Delaware in 2001 totaled 25%.

## Analysis

The goal of this critical review is to evaluate whether these "best practice" methods proposed by LS would actually achieve acceptable indoor air quality. LS's design criteria are *inter alia*, carbon dioxide (CO<sub>2</sub>) levels less than 1000 ppm, nicotine levels less than or equal to ( $\leq$ ) 40 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ), carbon monoxide (CO) levels  $\leq$  9 ppm, and respirable dust (RSP) levels  $\leq$  300  $\mu\text{g}/\text{m}^3$ . LS does not state whether these proposed Air Quality goals yield acceptable air quality, and does not specify a smoker density commensurate with these target levels. Moreover, no data are

given for the actual measured levels, nor what the smoker density was in the casino at that time. LS also proposes air exchange rates of 25 air changes per hour (ACH) for the Function, VIP and existing International rooms, an increase from "the current 8 ACH." LS proposes an increase "from 12 ACH" to 35 ACH for Private Gaming Salons. For bar areas within smoking-permitted rooms supply air is proposed over the bar area with returns in the patron area to "limit" the amount of smoke exposure of bar staff. LS does not specify the smoker density for any of the spaces. LS does not state whether these "current" air exchange rates are the result of actual measurements or are design values for those spaces.

In 1999, I issued an affidavit (Repace, 1999) in a legal case, Brook v. Burswood Casino. In a table (Table 4) in that affidavit, reproduced below as Table 1 in this evaluation, I compared my estimates of RSP and nicotine concentrations based on estimated smoker densities, and average air exchange rates, to actual measurements that had been made by others. My average estimated nicotine concentration, assuming a casino smoking prevalence of 29%, was  $23 \mu\text{g}/\text{m}^3$ , and average estimated RSP from SHS was  $250 \mu\text{g}/\text{m}^3$ , which compared very well to actual measurements. From the preceding paragraph we see that LS proposes to triple the air exchange rate over existing values. Holding smoker density constant, this would reduce the average air pollution from SHS by a factor of 3. However, if the new designated smoking-permitted rooms contain largely smokers, the new smoker density could increase by a factor of 3, negating the increase in ventilation. A major flaw in the LS report is that it does not specify the current or new smoker density, and does not appear to recognize that the concentration of SHS is directly proportional to the smoker density as well as inversely proportional to the air exchange rate.

**Table 1. Comparison of theoretical calculations for low, average, and high smoking occupancy and average ventilation vs. environmental measurements for the Burswood Casino from various depositions (Repace, 1999).**

Est.Nicotine Conc. ( $\mu\text{g}/\text{m}^3$ )	Meas.Nicotine Conc. ( $\mu\text{g}/\text{m}^3$ )	Est. Total RSP Conc. ( $\mu\text{g}/\text{m}^3$ )	Measured RSP Conc. ( $\mu\text{g}/\text{m}^3$ )
Repace Low: 3	LeSouef (p.252) 23.8	Repace Low: 50	LeSouef * 200-300
Repace <b>Ave.: 23</b>	Langley (p.217) 26.8	Repace <b>Ave.: 250</b>	Gordon (p.99) 216-476
Repace High: 41	HBI (Brook) 15.8	Repace High: 430	HBI (Brook) 62-226

\*Letter from Peter Le Souef, MD to Hon Ian Taylor dated 31 December 1996, quoting data presented by Burswood Casino 23/11/96 to Taskforce on Passive Smoking.

If we hold the Burswood smoker density constant, and if the air exchange rates are increased by a factor of 3, I conclude that at best, the exposure concentrations of SHS for Buswood Staff would decrease by a factor 3 to about  $80 \mu\text{g}/\text{m}^3$ . However, LS do not

specify a smoker density, and LS's target RSP concentration is nearly 4 times that level, at  $300 \mu\text{g}/\text{m}^3$ .

Further, the LS report makes no reference to the Australian National Occupational Health & Safety Commission (2005) criteria for treatment of known carcinogens (Appendix), a category in which SHS is included. NOHSC states that a carcinogen is Category 1 if it is "known to be carcinogenic to humans," i.e., there is sufficient evidence to establish a causal association between human exposure to these substances and the development of cancer. NOHSC states that "Under the circumstances where substitution of less hazardous materials is technically not feasible, the use of these carcinogenic substances should be controlled to the highest practicable standard by the application of effective engineering control techniques and, where necessary, complemented by the use of appropriate personal protective equipment. Routine monitoring of the workplace is essential for indication of control performance. In some cases, health surveillance and biological monitoring can indicate exposure and thus reveal the need for re-assessment of the control measures and work practices. For some substances, specific control measures have been detailed in codes of practice."

Such a code of practice for SHS has been issued by the Australian Ventilation Engineering profession, but is totally ignored in the LS Burswood proposal. This guidance called the Environmental Tobacco Smoke Harm Index (ETSHI) [AS 1668.2 Supplement 1—2002]. The ETSHI is used to estimate the mortality risk associated with a specified exposure to SHS in an environment that is ventilated and that may be fitted with an air cleaner, as in the LS proposal. Appendix A of the ETSHI guidance estimates the combined lung cancer and heart disease mortality risk for office workers in a typical smoking-permitted office as:  $\text{ETSHI} = 225$  deaths per million exposed workers per year. Assuming a 45-year working lifetime, this risk corresponds to a working lifetime risk of  $(45)(225 \text{ deaths/million}) = 10$  deaths per 1000 persons at risk. Repace (2005) estimated that the predicted respirable smoke particulate (RSP) concentration during work hours corresponding to this risk is  $211 \mu\text{g}/\text{m}^3$ . In fact, Repace (2004) measured an RSP concentration of  $205 \mu\text{g}/\text{m}^3$  in the Delaware Park Casino in the U.S., with a corresponding carcinogenic particulate polycyclic aromatic hydrocarbon (PPAH) concentration of 163 nanograms per cubic meter ( $\text{ng}/\text{m}^3$ ) before a Statewide smoking ban, and corresponding RSP and PPAH concentrations after the smoking ban of  $9 \mu\text{g}/\text{m}^3$  and  $4 \text{ ng}/\text{m}^3$  respectively. As Table 1 shows, measurements in the Burswood Casino are consistent with these values.

LS's target concentrations for nicotine and RSP do not represent a significant change from the existing measured values. An RSP concentration of  $211 \mu\text{g}/\text{m}^3$  is about 2/3 of LS's target value. Thus LS's target concentration of  $300 \mu\text{g}/\text{m}^3$  would have an estimated risk for Burswood casino staff of about 15 per 1000, or 15 times the OSHA Significant Risk level, and 10,000 times the U.S. *de minimis* or "acceptable risk" level carcinogens in air, water, or food (Travis et al., 1990; Repace et al., 1998). Moreover, LS presents no modeling to show that even these target values would be attained if its technology is adopted or has been attained in practice elsewhere. Assuming a best-case

3-fold reduction in concentration, at  $80 \mu\text{g}/\text{m}^3$ , the risk would be  $(80/211)(10 \text{ per } 1000) = \sim 4 \text{ per } 1000$  (rounded). Thus the estimated range in risk is between 4 and 15 per 1000, with the most likely value, based on measured data in Table 1 above, about 10 combined deaths from heart disease and lung cancer per 1000 workers per working lifetime of 45 years. This risk range is  $(10 \text{ per } 1000)/(1 \text{ per } 1,000,000) = 10,000$  times the de minimis or “acceptable” risk level. Therefore I find the LS proposal to be without merit in achieving acceptable indoor air quality in the Burswood Casino.

On the other hand, a total ban on smoking in the Burswood Casino – an option not considered in the LS report, would reduce the excess risk of mortality from SHS to zero.

## Conclusions.

- Under the Lincolne Scott proposal, to use ventilation technology to control SHS, Burswood Casino staff would be exposed to an unacceptable risk of morbidity and mortality from lung cancer, heart disease, as well as respiratory disease.
- Assuming a 3-fold reduction in measured concentrations of SHS under the LS proposal, Burswood Casino staff's would have a residual estimated working lifetime (45 yr.) mortality risk of lung cancer and heart disease from SHS 4 per 1000, compared to U.S. OSHA's level of 1 death per 1000 workers, defined as "significant risk of material health impairment." At the target concentration listed in the LS proposal, this risk would be 15 per 1000. At the level of the typical measured data for the Burswood Casino, estimated excess risk due to SHS is very hazardous, at 10 times the Significant Risk level, and 10,000 times the *de minimis* or acceptable risk level.
- Casino staff's estimated risk is significant, material, and substantial, and there is no reasonably practical means of mitigating, reducing, or avoiding the risk other than smoke-free working conditions.
- Smoking bans, rather than ventilation technology, constitute "best practice" for the control of secondhand smoke.
- The Lincolne Scott report is flawed because it does not specify the casino smoker density, ignores the guidance of the Australian Ventilation Engineering profession, establishes air quality goals which produce air pollution levels consistent with massively unacceptable health risks for casino workers, and fails to compare the efficacy of its proposed ventilation technology to smoking bans.

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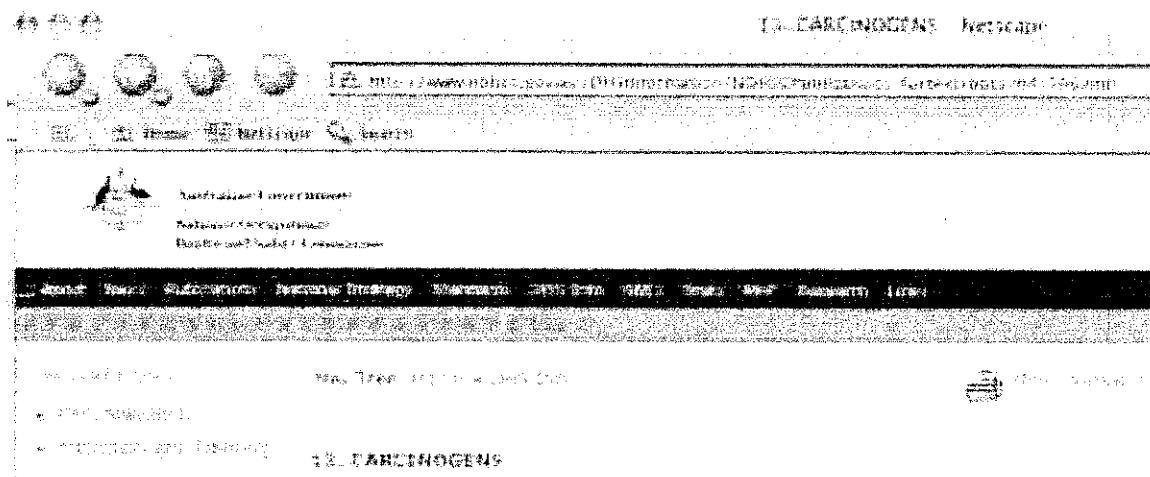
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## Appendix A. National Occupational Health & Safety Commission (2005)

<<http://www.nohsc.gov.au/OHSInformation/NOHSCPpublications/fulltext/docs/h4/596.htm>>



### 13. CARCINOGENS

13.1 Unlike most chronic toxic effects, which usually manifest themselves sometime during the period of exposure, a carcinogenic process, from the initiating event to clinical expression of the disease, may take from a few to many years to complete. A diagnosis of cancer may not be made until long after cessation of exposure.

13.2 The incidence of cancer is usually dose related; the greater the exposure to the chemical carcinogen the higher the risk of developing the cancer associated with that chemical. Accordingly, the smaller the exposure the lower the probability of a cancer developing.

13.3 Because of the limitations of both epidemiological and animal studies at very low dosage, 'no effect' levels of exposure cannot be confidently identified for carcinogenic substances at the present time. Nevertheless, there do appear to be practical thresholds for most carcinogens at which the effects cannot be distinguished against the natural background,<sup>33</sup> although for some of the more potent carcinogens elimination of exposure is the only recommendable goal.

13.4 Since some carcinogenic substances are unavoidable in particular industrial processes, and to some extent also occur in nature, it may be impossible to eliminate exposure to these substances completely. For this reason the following general guidelines should be observed:

- \* Substances which have been identified as carcinogens should be replaced, where possible, by substances which are not carcinogenic and are less hazardous.
- \* Engineering controls, such as exhaust ventilation, process enclosure and/or improved work practices, should be implemented to eliminate or minimise worker exposure. As skin absorption can be a significant source of exposure for some carcinogens, particular

attention may need to be given to plant hygiene and the selection of appropriate skin protection.

\* Routine air monitoring, or biological monitoring where appropriate, should be employed in the workplace to ensure exposure is being maintained at the minimum which can be practically achieved, and in all cases below the appropriate exposure standard. Because the levels of exposure may be very low, analytical methods of appropriate sensitivity should be employed. The frequency at which monitoring is undertaken is determined by the magnitude of the potential exposure and the reliability of the process controls.

\* Where exposure to these substances cannot be eliminated by the use of process control techniques, the use of personal protective equipment may be required. The selection of appropriate protective equipment will be determined not only by the nature and magnitude of the potential exposure, but also by the particular chemical and physical characteristics of the substance and the nature and magnitude of its carcinogenic effect.

\* All personnel likely to be exposed to carcinogenic substances should receive adequate information regarding the hazards, and training in minimisation of risk.

13.5 Although exposure to potentially carcinogenic substances should be eliminated or reduced to as low a level as is practicable, the use of exposure standards can, in many cases, act as a useful guide to the efficiency of engineering controls and the work practices which have, or need to be, implemented to reduce worker exposure.

13.6 To this end, where there is sufficient information to allow the assignment of exposure standards, these are given as a guide to good practice. However, because of the incompleteness of our knowledge of carcinogens, it is at present not possible to reliably estimate the risk posed by some carcinogenic substances. Therefore, compliance with these exposure standards should not preclude further efforts to reduce worker exposure.

13.7 Chemical substances which have been identified as suspected or established carcinogens, or substances associated with industrial processes which have been identified as suspected or established carcinogens, have been highlighted in the list of adopted exposure standards. The Commission of the European Communities (EEC) system of classification of carcinogenic substances<sup>34</sup> is used to indicate the strength of the causal association between these substances and the development of cancer. (Note: The categorisation of individual substances by the Exposure Standards Working Group may vary from the EEC assignment in some instances.) A detailed description of the criteria used in this classification system is available in A Guide to the Classification of Carcinogens, Mutagens and Teratogens under the Sixth Amendment,<sup>35</sup> which is based on the interpretation, for human exposure at the workplace, of the findings of the International Agency for Research on Cancer on carcinogenesis. The most stringent of the three categories, with the appropriate levels of control required, is described below.

**(a) Category 1**

**Established human carcinogens are those substances known to be carcinogenic to humans. There is sufficient evidence to establish a causal association between human exposure to these substances and the development of cancer.**

**Under the circumstances where substitution of less hazardous materials is technically not feasible, the use of these carcinogenic substances should be controlled to the highest practicable standard by the application of effective engineering control techniques and, where necessary, complemented by the use of appropriate personal protective equipment. Routine monitoring of the workplace is essential for indication of control performance. In some cases, health surveillance and biological monitoring can indicate exposure and thus reveal the need for re-assessment of the control measures and work practices. For some substances, specific control measures have been detailed in codes of practice.<sup>5,6,36</sup>**

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