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CS ENERGY PROCEDURE

HEALTH HAZARD EXPOSURE MANAGEMENT
CS-OHS-75

Responsible Officer: Health and Safety Specialist
Responsible Manager: Head of Health, Safety and Environment
Responsible Executive: Executive General Manager People, Safety and Transformation

DOCUMENT HISTORY

Key Changes	Prepared By	Checked By	Approved By	Date
Original Release	H Lonsdale N Seibel	A Cashin B Pike D Clarke G Wellings (GCG)	S Faulkner	02/11/2018
Update with hexavalent chromium, dust levels, remove reference to Wivenhoe	N Seibel	T Hoare A Cashin	N Moran	20/08/2021
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Review and update, add location links, remove obsolete document references, update references and definitions	L Jones	L Hartley	B Prain	27/06/2025

CONTENTS

1 PURPOSE

Exposure to substances or environmental conditions in the workplace can pose health risks to workers. The extent to which a person is exposed depends on the concentration of a substance, the amount of time they are exposed to a condition and the effectiveness of controls. Exposures may cause immediate acute health effects, or it may be decades before effects become evident.

This procedure describes the process for health hazard exposure management at CS Energy.

2 SCOPE

The procedure applies to all activities undertaken at CS Energy and all people exposed to potential health hazards.

Hygiene risks are to be understood and managed at all sites. The framework in Figure 1 describes the various process steps involved and the related activities for each step.

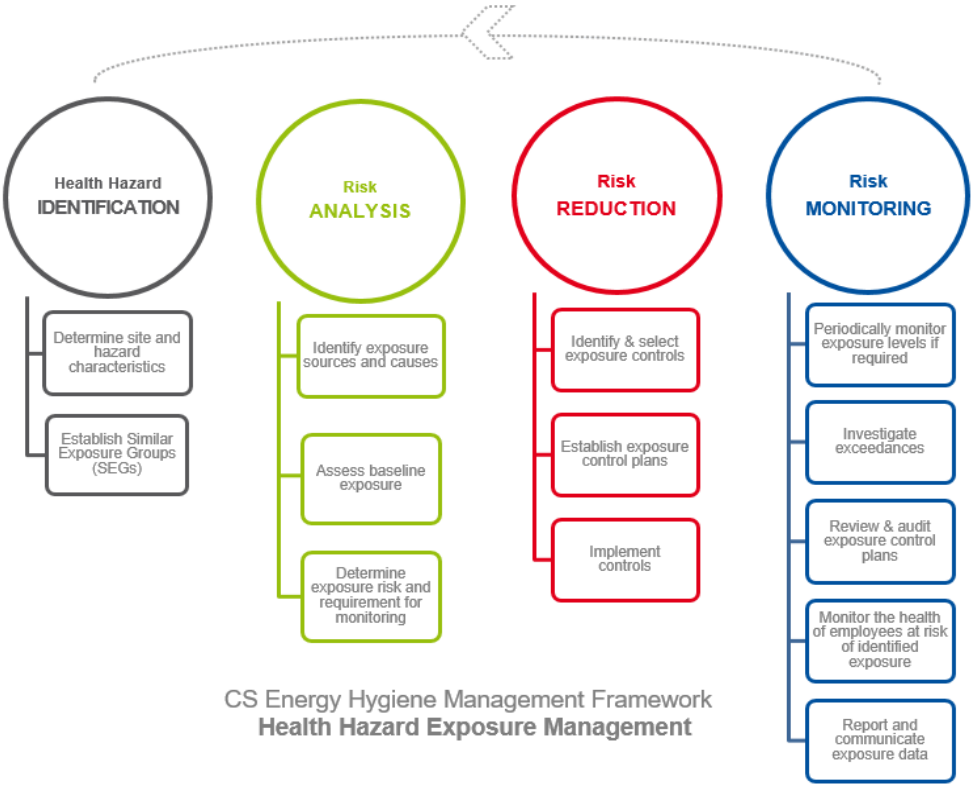

Figure 1 Hygiene Risk Mangement Frame Work

3 RESPONSIBILITIES AND ACCOUNTABILITIES

3.1 Management

Management are responsible for ensuring that:

- This procedure is followed and that adequate resources are available to ensure effective hygiene management
- They are well informed about issues identified with hygiene management
- Hygiene risk assessments are completed in relevant work areas
- Exposure testing and health monitoring is conducted for identified hygiene risks

- Areas which are known hygiene hazards are signposted as required.

3.2 Health and Safety Specialist

The Health and Safety Specialist is responsible for ensuring that:

- A program is implemented for exposure monitoring as identified by risk assessment and legislative requirements
- Specialist advice is obtained regarding exposure assessments and health surveillance
- Health surveillance requirements are identified, and a program coordinated
- An annual review of the hygiene monitoring program is completed
- Education and awareness programs are developed and delivered for significant hazards identified by the hygiene risk assessments.

3.3 Health and Safety Business Partners

The Health and Safety Business Partners are responsible for ensuring that:

- Risk assessments are coordinated for all likely hygiene risks and monitoring is conducted as required
- Where required, technical advice is sought for hygiene risks on site
- Exposure monitoring is conducted in compliance with the schedule
- Management is assisted with the development of control plans to reduce exposure
- Health surveillance is conducted in compliance with the schedule.

3.4 Supervisors

Supervisors are responsible for ensuring that:

- Adequate resources are allocated for compliance to this procedure within their area of responsibility
- Hygiene risks are understood and managed within their area of responsibility
- Workers understand their role in this procedure.

3.5 Workers

Workers are responsible for ensuring that:

- They comply with the requests to participate in occupational hygiene monitoring
- They employ controls associated with identified health hazards in their work area
- Identified hygiene hazards are reported to their supervisor and recorded.

4 HAZARD IDENTIFICATION

4.1 Determine site and hazard characteristics

CS Energy will seek specialist advice in relation to hazardous processes and the level of risk that they may pose to the health of workers. Workers may also identify potential health hazards that need to be risk assessed and these must be raised with a Supervisor or a member of the Health & Safety team.

- The workplace and workforce must be analysed to determine exposure risks. The aim of the characterisation process is to develop an initial profile of the site to assist in occupational

hygiene hazard identification, exposure assessment prioritisation and monitoring of employee exposures.

- Consideration should be given to the following:
- Site description and layout
- Process and nature of work
- Workforce considerations (departments, jobs and tasks performed, number of employees, shift rosters).

4.2 Similar Exposure Groups (SEGs)

Using the information gathered as part of the characterisation, workers who have the same general exposure to health risks are grouped into Similar Exposure Groups (SEGs).

- SEGs at CS Energy have been determined on each site and are detailed in CS-OHS-14 Managing Respirable Dust

5 RISK ANALYSIS

5.1 Identify exposure sources and causes

Exposure agents must be analysed to determine exposure risks. The resulting analysis is referred to as the Hygiene Risk Assessment (HRA). The HRA can be undertaken via;

- Qualitative exposure assessment, where no or insufficient exposure data exists
- Quantitative exposure assessment, where sufficient data is available (Note: personnel performing such assessments should understand the impact of the sample size, sample variation, effect of outliers in the data set and consistency with knowledge and understanding of the process and activities performed).

Consideration should be given to the following in both qualitative and quantitative HRAs;

- Products, by-products, raw materials, waste streams, process reagents etc
- Emission points
- Nature of emissions
- Potential health effects
- Specific historical exposures.

Exposure risk ratings are assessed against CS Energy's risk matrix – refer Risk Matrix (CS-RISK-01 / CS-RISK-03) - Risk Management Framework (03/15) - CS Energy Registered B/D/13/17881

5.1.1 Qualitative Health Risk Assessment

An observational site inspection should cover all exposure agents and SEGs identified based on the initial site and hazard characterisation and the following factors:

- The types of control measures currently in place and their observed effectiveness
- PPE compliance
- Visual indicators of exposure potential
- Activities conducted
- Worker experiences/perceptions
- Historic exposure/incidents

- Control measures in place

5.1.2 Quantitative Health Risk Assessment

The types of quantitative assessment that are used to assess exposures are:

- Baseline exposure assessment
- Ongoing monitoring program
- Campaign exposure assessments

Quantitative assessment of occupational exposures is generally performed where:

- The SEG exposure to an agent is qualitatively assessed as possibly exceeding the 50% of the OEL or other established criteria (estimated exposure risk is significant or high)
- Data analysis of the historic quantitative data identified the SEG exposure to an agent as exceeding 50% of the OEL
- The exposure estimate for a specific contaminant is unclear and requires further characterisation.

5.2 Exposure Monitoring

All monitoring data is to be analysed by a suitably trained and competent person. A third party accredited laboratory i.e. NATA accredited methods are used to analyse monitored samples. Validated Australian Standard methods will be used or equivalent from an internationally recognised standard.

The equipment used for monitoring must be fit for purpose, regularly inspected and calibrated as required for each individual monitoring device.

All records must be retained for minimum period of 30 years.

5.2.1 Baseline Monitoring

A baseline sampling program is conducted for new potentially significant exposure activities to establish an exposure profile. The number of samples to be collected for each SEG must be determined to ensure that at least one worker from the sample group with be in the top 20 percent of the exposure occurring in the group to a confidence limit of 90 percent.

- Quantitative exposure assessment must be based on personal monitoring where methods are available. ‘Static’, fixed-place or area monitoring, is not to be used as a means of defining personal exposures. The exposure assessment must be reported without consideration for the protection provided by any Personal Protective Equipment (PPE) worn during the measurement period.
- In some instances, the conduct of personal monitoring to quantitatively assess exposure may not be applicable (e.g. whole-body vibration, thermal stress) and a ‘survey’ focused method may need to be employed.

5.2.2 Requirement for ongoing monitoring

Following the completion of the Baseline Exposure Assessment and risk analysis, the need for ongoing monitoring is to be assessed. Once the sampling required for a SEG has been identified and the desired number of samples determined, a monitoring schedule is developed.

A monitoring program is to be conducted when:

- A qualitative or quantitative exposure profile assessment identifies a SEGs exposure to an agent as exceeding 50% of the OEL or other established criteria.

- The exposure estimate for a specific contaminant is unclear and requires further characterisation.

Note: The main Occupational Exposure Limits (OELs) for the CS Energy risks identified at CS Energy facilities are listed in Attachment 1 – Occupational Exposure Limit Table.

Additional OELs shall as a minimum be those documented in Safe Work Australia - Exposure Standards.

In the absence of an appropriate SafeWork occupational exposure limit, a comparable regulatory authority / advisory body must be sourced to determine occupational exposure limits.

OELs are based on an 8-hour day, 5 day working week. Exposure standards may need to be adjusted depending on different shift arrangements to ensure workers maintain the levels of controls adequate for an individual. Shift adjustments will be made in accordance with the IRSST method, or, as directed by a Certified Occupational Hygienist familiar with the exposure being assessed.

- Substances with acute effects will be adjusted based on total shift length
- Substances with chronic health effects will be adjusted on average weekly hours worked (determined from the roster / shift rotation pattern.
- Short Term Exposure Limits and Peak Limitations will not be adjusted
- Noise exposures will be adjusted according to Australian Standard 1269

Where mixed exposures occur, each substance must initially be assessed and compared to it's individual OEL as detailed above. For substances which have similar health effects, and there may be reason to believe that the effects of the constituents are synergistic or additive, the mixed exposure should also be assessed.

6 RISK REDUCTION

6.1 Identify and select exposure controls

Where there is a risk of significant exposure identified, appropriate controls must be implemented to decrease exposure levels taking into consideration the hierarchy of controls. If exposures cannot be controlled immediately through elimination, substitution, separation or other engineering controls, then interim controls such as the use of Personal Protective Equipment (PPE) shall be implemented according to Australian Standards to help manage personal exposure.

6.2 Establish exposure control plans

Where analysis has identified that a SEG has a significant risk of exposure, an investigation shall be facilitated by the health and safety team in conjunction with line management and employee representatives. The intention of this investigation is to determine the sources of exposure and develop a list of potential control options. Controls may already be in place in which case they should be documented in relation to the risk they address. For inherently significant risks this will be documented in the Enterprise Risk Management System.

It is anticipated that sites will have both common controls and local controls that address exposure for specific groups.

Guidance on controls for specific hazards is listed in Attachment 2 – Guidance for management and control of identified health hazards

6.3 Implement controls

Upon completion of the investigation, a list of potential control options will be provided to the risk owners, and it will be the responsibility of the risk owner to allocate a control owner and implement the appropriate controls.

7 RISK MONITORING

7.1 Periodically monitor exposure levels

Monitoring may be used to assess the effectiveness of controls (i.e. pre/post control testing), or to quantify a specific exposure related to a task or event.

7.2 Investigate Exceedances

Individual samples collected as part of any exposure monitoring program should be investigated where:

- An individual's sampling result exceeds 50% of the OEL, for all samples except noise.
- Noise exceedances should be investigated when results exceed 50% of the OEL and hearing protection is not worn.
- An individual's exposure to any agent is 'abnormal', that is, the result is inconsistent with the HRA or previous results.

Exposure exceedances meeting the above criteria shall be entered in CGR Insight in accordance with the **Learning from Incidents Procedure CS-IM-01** B/D/11/45318**.** The **Review of Hygiene Exceedance Form B/D/17/17188** must be completed, and a copy of the review should be saved in the relevant incident investigation file in TRIM.

All actions identified after completing the appropriate level of investigation shall be tracked to completion.

The requirements to resample a SEG following an exceedance should be determined as the outcome of the investigation. Resampling should generally occur following the implementation of additional controls to verify the effectiveness at reducing exposure levels.

A summary of single sample dust exceedance results must be reported to the WHS Regulator in a format approved by the Regulator. In addition, the WHS Regulator should be informed as soon as reasonably practicable following the investigation and the decision-making process relating to further action.

7.3 Review and audit exposure control plans

Where controls have been implemented to reduce an exposure, or minimise the risk associated with an exposure, the effectiveness of these controls must be verified by means of either monitoring, inspection, auditing or by other means deemed appropriate at intervals determined by the Health and Safety team.

7.4 Monitor the health of employees

Health Surveillance is a system of ongoing health monitoring. In the workplace, this is undertaken with workers who have exposures to hazards that have known or suspected health risks. It is designed to detect ill health effects in workers at an early stage and allow improvement of controls to prevent the development of disease.

It is a legal requirement for employees who are exposed to specific hazards to undergo health surveillance. The health monitoring for workers, including contractors is a shared duty between the persons conducting a business or undertaking to ensure health monitoring is provided.

CS Energy's Occupational Physician will periodically review site hygiene risk assessments and advise of any requirement for the workers belonging to a SEG to undergo health surveillance.

Any exceedance of the relevant occupational exposure limits will be referred to the Health and Safety Specialist who will refer to the Occupational Physician for advice.

The determined health surveillance will be scheduled, and medical assessment records kept on secured personal files.

7.5 Report and communicate exposure data

CS Energy maintains a health exposure risk profile. The profile defines the exposures that apply to various work groups and ranks their risk in accordance with the HRA. CS Energy health exposure profile is maintained in TRIM and updated to reflect data and analysis as it becomes available. Refer to TRIM F/18/1630.

In addition, all inherently significant health exposure risks and associated controls are captured in the Enterprise Risk Management System.

An annual data analysis is required once the exposure profile is determined. Changes in exposure profile must be reported to the management team and specifically:

- SEGs with an exposure profile >100% of the Occupational Exposure Limit (OEL)
- SEGs with an exposure profile 50-100% of the OEL
- Any action required to progress initiatives to reduce the exposure of workers.

The outcome of any hygiene exposure assessment monitoring must be communicated to those affected. The level of detail, the information provided, and the frequency is set out in the table below.

Type of Communication	To Whom	When
Survey Reports	Health and Safety Business Partners Site Management Team Supervisors as required	Within 1 weeks of the survey report receipt
Individual Exceedance or 'abnormal' results in Survey Reports	Site Management Team Supervisors as required Health and Safety representative for the relevant workgroup WHS Regulator (dust only)	As soon as possible after receiving the survey report (and once the investigation is complete).
Personal Monitoring Letters	Monitored individual	Following receipt of survey report
Toolbox, Noticeboard	Workers (employees and contractors) in affected SEG	Within 1 week of report receipt
Reporting of exposure data analysis	Central Health Safety & environment Committee People and Safety Committee	At least annually
Annual exposure profile statistical data analysis and review	Health and Safety team Site Management team	Annually
SEG exposure data	Occupational Physician	Annually
Health Risk Assessment (HRA)	Site	2 yearly

8 DEFINITIONS

Term	Definition
CAS	Chemical Abstracts Service – Registered number of identified hazardous chemical
HRA	Hygiene Risk Assessment is a documented assessment of health hazards and qualitative risk assessments at CS Energy
Occupational Hygiene	Occupational hygiene uses science and engineering to measure the extent of worker exposure, and to design and implement appropriate control strategies to prevent ill health caused by the working environment. It helps employers and employees understand the risks and promotes improved working conditions and working practices.
OELs	Occupational Exposure Limit is the maximum permissible concentration of a given gas, vapour, fibre or dust in the air in the workplace

Term	Definition
VOC	Volatile Organic Compounds - a large group of carbon-based chemicals that easily evaporate at room temperature due to their high vapor pressure and low water solubility. This volatility means they can quickly become gases and enter the breathing zone.
NOC	Not otherwise classified
Qualitative Hygiene Risk Assessment	Evaluation of potential personal exposure to workplace chemicals, physical, radiological, and/or biological agents based on personal experience and professional judgment.
Quantitative Hygiene Risk Assessment	Evaluation of actual personal workplace exposure to chemical, physical, radiological, and/or biological agents using accredited numerical and mathematical analysis.
SEG	Similar Exposure Groups are groups of workers who have the same general exposure to risk, for example: • The similarity and frequency of the tasks they perform • The materials and processes with which they work • The similarity of the way they perform tasks
MMVF	Man-Made Vitreous Fibres Previously referred to as *Synthetic Mineral Fibres (SMF)*, MMVF are a group of manufactured fibres made from glass, rock, slag, or other minerals that are melted and spun or drawn into fibrous forms. Common types include glass wool, rock wool, and refractory ceramic fibres. These materials are used extensively for insulation, soundproofing, and fire protection in both residential and industrial settings.
WES	Workplace Exposure Standards - Workplace Exposure Standards (WES) are legal limits on the concentration of airborne contaminants—like dusts, gases, vapours, and fumes—that workers can be exposed to during their job. These standards are designed to protect workers' health by ensuring that exposure to hazardous substances stays below levels known to cause harm. These standards are currently being updated. From 1 December 2026, the term will shift to Workplace Exposure Limits (WEL) to better reflect international terminology and emphasise that these are maximum allowable concentrations, not just guidelines.

9 REFERENCES

Reference No	Reference Title	Author
	Workplace exposure standards for airborne contaminants	SafeWork Aust
	Guide to measuring and assessing whole body vibration	SafeWork Aust
	Guide to managing risks of exposure to hand arm vibration	SafeWork Aust
	Model Code of Practice: Managing noise and preventing hearing loss at work	SafeWork Aust
Part 4.1 Noise	Work Health and Safety Regulation	Qld Govt
	Managing the risks of plant in the workplace Code of Practice	Qld Govt
B/D/12/1363	CS-OHS-50 Personal Protective Equipment (PPE)	CS Energy
B/D/11/30966	Asbestos Management Plan	CS Energy
B/D/18/6609	CS-OHS-76 Health and Safety Risk Management	CS Energy
B/D/11/45318	CS-IM-01 Learning from Incidents	CS Energy
B/D/17/15576	Health Risk Assessment – Callide	GCG
B/D/17/15574	Health Risk Assessment – Kogan	GCG
B/D/17/19863	Health Risk Assessment – Brisbane	GCG
B/D/17/17188	Form – Review of Hygiene Exceedance	CS Energy
B/D/18/18030	Dust Control Plan – Callide	CS Energy
B/D/18/22955	Dust Control Plan - Kogan	CS Energy

Reference No	Reference Title	Author
B/D/12/63934	CS-RISK-01 Risk Management Framework	CS Energy
B/D/13/17881	CS-RISK-01 Risk Management Framework - Attachment	CS Energy
	CS-OHS-14 Management of Respirable Dust	CS Energy
B/D/11/30976	CS-OHS-08 Management of Hazardous Substances and Regulated Waste	CS Energy
B/D/11/30949	CS-OHS-24 Working in Heat	CS Energy
B/D/11/30950	CS-OHS-25 Noise Management	CS Energy
B/D/11/30966	CS-OHS-43 - Asbestos Management Plan	CS Energy
B/D/12/84199	CS-OHS-57 - Identifying and Assessing Hazardous Manual Tasks	CS Energy
B/D/12/15438	S1844 - Cooling Tower ACW Pre Entry Health Assessment Checklist	CS Energy

10 RECORDS MANAGEMENT

In order to maintain continual improvement, suitability, safety and effectiveness of the organisation, registered documents will be reviewed on a two-yearly basis or at intervals specified by legislative or regulatory requirements. Review of controlled documents should occur where it has been identified that there are changes in technology, legislation, standards, regulation or where experience identifies the need for alteration to the content. Registered documents should also be reviewed following an incident, change management process, modification or where directed as part of a risk assessment process. A 'review' can simply mean that it has been identified, confirmed and appropriately recorded that no changes are required and that the existing process remains the same.

Government Owned Corporations must ensure that records are retained according to accountability, legal, administrative, financial, commercial and operational requirements and expectations. In compliance with records retention and disposal, all documentation created in relation to business must be retained in line with minimum retention periods as detailed in legal retention and disposal schedules.

11 ATTACHMENTS

11.1 Attachment 1 – Occupational Exposure Limit Table

Substance	CAS Number	WES / OEL	Notes
KEY		TWA (Eight hour Time weighted average STEL Short term exposure limit PPM parts per million Mg/m3 milligram per cubic metre of air EAV – Exposure Action Value ELV – Exposure Limit Value	Sk: absorption through skin Sen: Respiratory and/or Skin sensitiser Advisory Carcinogen category 1A Known to have carcinogen 1B Presumed to have 2 Suspected to have
Ammonia	7664-41-7	TWA 25ppm, 17mg/m3 STEL 35ppm, 24mg/m3	
Asbestos (all)	12001-29-5 (chrysotile) 12172-73-5 (Amosite) 12001-28-4 (Crocidolite) 1332-21-4	All – 0.1 f/mL	IARC Group 1
Benzene	71-43-2	TWA 1ppm, 3.2mg/m3	IARC Group 1
Chlorine	7782-50-5	Peak 1 ppm, 3 mg/m3	
Chromium Metal	7440-47-3	TWA 0.5 mg/m3	IARC Group 1
Copper (fume)	7440-50-8	TWA 0.2 mg/m3	
Ethyl Benzene	100-41-4	TWA 100ppm, 434 mg/m3 STEL 125ppm, 543 mg/m3	IARC Group 2B
Inhalable Dust (not otherwise classified) *		TWA 10mg/m3^	*Nuisance dusts ^ As described in "*Guidance on the interpretation of workplace exposure standards for airborne contaminants*"
Iron Oxide fume (Fe2O3) (as Fe)	1309-37-1	TWA 5 mg/m3	
Isocyanates, all (as NCO)	7439-92-1	TWA 0.02 mg/m3 STEL 0.07 mg/m3	Sen IARC Group 2B (TDI) IARC Group 3 (Others)
Lead, inorganic dusts & fumes (as Pb)	7439-92-1	TWA 0.05mg/m3	IARC Group 2A
Manganese, fume (as Mn)	7439-96-5	TWA 1mg/m3 STEL 3mg/m3	
Nickel, metal	7440-02-0	TWA 1 mg/m3	IARC Group 2B Sen
Nitrogen Dioxide	10102-44-0	TWA 3ppm, 5.6mg/m3 STEL 5ppm, 9.4mg/m3	
Noise		TWA (a) LAeq,8h of 85 dB(A); or (b) LC, Peak of 140 dB(C).*	*Work Health and Safety Regs. 2011
Respirable Coal Dust		TWA 1.5mg/m3	

Substance	CAS Number	WES / OEL	Notes
Respirable Dust (NOC)		TWA <3mg/m3 AIOH TWA 1mg/m3	
Silica, crystalline	Quartz 14808-60-7	TWA 0.05mg/m3	IARC Group 1
Styrene, Monomer	100-42-5	TWA 50ppm, 213 mg/m3, STEL 100ppm, 426 mg/m3	IARC Group 2B
Sulphuric Acid	7664-93-9	TWA 1mg/m3 STEL 3mg/m3	IARC Group 1 (as acid mists, strong inorganic)
MMVF **(formerly SMF)**	Glass wool, rock wool, slag wool and continuous glass filament / Low biopersistence fibres	2 mg/m^3 (8 hour TWA)	Varies by fibre type; some IARC Group 2
	Special purpose fibres / RCF / High biopersistence fibres	2 mg/m^3 (inhalable) & 0.5fm/L(respirable) (8 hour TWA)	
Toluene	108-88-3	TWA 50ppm, 191 mg/m3 STEL 150ppm, 574 mg/m3	Sk Absorption through the skin may be a significant source of exposure.
Vibration (Whole Body)*		RMS Acceleration EAV 0.5 m/s^{-2} RMS Acceleration ELV 1.15 m/s^{-2} Vibration Dose Value EAV 9.1 m/s$^{1.75}$ Vibration Dose Value ELV 21 m/s$^{1.75}$	Exposure Standards considered good practice; not legislated in Australia *As referenced in EU2002/44/EC Physical Agents (Vibration) Directive
VOC		*	*No specific exposure standard for VOC's as a group.
Welding fumes (NOC)		TWA 1mg/m3	IARC Group 1
Xylene (o-, m-, p-isomers)		TWA 80ppm, 350mg/m3 STEL 150ppm, 655 mg/m3	

NB – the OELs provided in this table will be adjusted depending on different shift arrangements.

11.2 Attachment 2 – Guidance for management and control of identified health hazards

11.2.1 Ammonia

Ammonia	
Overview	Ammonia is a colourless gas with a characteristic pungent smell. It is lighter than air, its density being 0.589 times that of air. It is easily liquefied due to the strong hydrogen bonding between molecules; the liquid boils at −33.3 °C (−27.94 °F), and freezes at −77.7 °C (−107.86 °F) to white crystals. Liquid ammonia possesses strong ionising powers. Liquid ammonia has a very high standard enthalpy change of vaporization and can therefore be used in laboratories in uninsulated vessels without additional refrigeration. Acute inhalation of ammonia causes rapid onset of signs and its toxic effects are mediated through its irritant and corrosive properties. Features include irritation to the nose, throat and respiratory tract. Increased lacrimation, coughing, an increased respiratory rate as well as respiratory distress may occur. Substantial exposures can cause burns of all depths in the oral cavity, nasopharynx, larynx and trachea, together with airway obstruction and bronchiolar and alveolar oedema. Chronic inhalation is associated with increased cough, phlegm, wheeze and asthma.
Source	Unit feed water – 1.5% solution Laboratory reagent – 28%
Exposure Standard	TWA 8hr day 17 mg/m3
Health Effects	Acute upper respiratory tract and eye damage, chronic cough, increased asthma frequency
Monitoring Requirements	Maintenance on Ammoniaguard for cylinders in service
Control Methods	**Substitution/Elimination** Removal of ammonia from water treatment process **Engineering** Isolation & Lock-out **Administration** Permit to Work Ammonia Monitoring Safety checks – inspections, calibration, maintenance Training Records – monitoring and inspections Storage ChemAlert - SDS PPE Safety glasses/goggles Gloves Safety showers?

11.2.2 Asbestos

Asbestos	
Overview	Asbestos is defined as the fibrous form of mineral silicates belonging to the serpentine and amphibole groups of rock-forming minerals, including actinolite, amosite (brown asbestos), crocidolite (blue asbestos), chrysotile (white), tremolite, or any mixture containing one or more of these. Asbestos-containing materials (ACM) may still be encountered in buildings and structures, especially those built between the 1950s to early 1980s. Some uses of ACM continued until 2003, notably in friction materials (brakes) and gaskets. Asbestos fibres are strong, heat resistant and have insulating properties. Asbestos fibres are not visible to the naked eye. They are very light, remain airborne for a long time, and can be carried by wind and air currents over large distances Asbestos fibres do not dissolve in water or move through soil. They are generally not broken down to other compounds and remain virtually unchanged over long periods.

Asbestos	
	Chronic exposure to asbestos fibres increases the risk of progressive fibrotic lung diseases, reduced lung function and exercise capacity, development of benign pleural plaques, increased risk of lung and pleural cancers.
Source	Asbestos Materials e.g. Thermal or acoustic insulation which is friable Asbestos Containing Materials (ACM) e.g. asbestos cement products, friction materials, gaskets
Exposure Standard	TWA (8hr) 0.1 mg/m3
Health Effects	Pleural Plaques Asbestosis Progressive Fibrotic lung disease Mesothelioma Lung Cancer
Monitoring Requirements	Air and dust sampling – 12-month intervals – friable vs ACM
Control Methods	**Substitution/Elimination** Removal of asbestos containing materials **Engineering** Encapsulation and sealing Enclosure/isolation **Administration** Asbestos Removal Control Checklist Asbestos register Asbestos Management Plan Asbestos inspections and audits Training – asbestos removal Clearance inspections Asbestos labelling and signage Records – monitoring and inspections, survey reports Storage, waste Supervision ChemAlert – SDS Health surveillance Air monitoring PPE Respiratory protection Goggles Coveralls Laundering of contaminated clothing
Reference	CS Energy Asbestos Management Plan CS Energy Asbestos Register Code of Practice How to Safely Remove Asbestos 2011 Code of Practice How to Manage and Control Asbestos in the Workplace 2011

11.2.3 Biological Agents (Legionella)

Biological Agents (Legionella)	
Overview	Legionella bacteria can be found in most fresh-water environments, in natural and constructed water sources and in the soil. Sampling and testing of these water sources for Legionella will invariably find its presence. If conditions are favourable to the micro-organisms, Legionella bacteria can live and multiply rapidly in the water of a cooling tower, spa or tepid water systems and, if

Biological Agents (Legionella)	
	susceptible persons inhale contaminated water vapour from these systems, they may contract the disease. Many infections by Legionella pneumophila do not result in recognisable signs and symptoms. Commonly a person may have been ill and not realised that the cause was exposure to Legionella bacteria. It is reported that up to 30 per cent of healthy Australians may show evidence of previous infection by positive antibody tests. Fatalities associated with Legionnaire's Disease have been associated with cooling towers, spas, tepid water systems and potting mix.
Source	Cooling towers Dam water Raw water pipeline Potting mix
Exposure Standard	N/A
Health Effects	Mild respiratory illness Pontiac Fever (Influenza like illness) Legionnaire's Disease (Pneumonia like illness)
Monitoring Requirements	Water sampling (weekly, monthly and 6 monthly)
Control Methods	**Substitution/Elimination** Prohibit use of cooling towers. **Engineering** Chemical dosing – cleaning and disinfection **Administration** Servicing and inspection – maintenance program Access and egress Monitoring – records Incident management - INSIGHT ChemAlert – SDS Signage **PPE** Respiratory Protection Program – P2 respirator
Reference	Guide to Legionella control in cooling water systems, including cooling towers AS 3666 Ait handling and water systems of buildings-microbial control AS 5059 Power Station Cooling Tower Water Systems - Management of Legionnaires Disease Health Risk

11.2.4 Chlorine

Chlorine	
Overview	Chlorine exists as a gas at normal temperature and pressure. The gas is pressurised and cooled to liquid form for storage and shipping. When released, it rapidly forms a yellow-green gas that stays close to the ground and spreads rapidly. Chlorine gas is not flammable, but it can react explosively with other chemicals such as turpentine and ammonia. It can be recognised by its pungent, irritating, bleach-like odour which usually provides warning of exposure. Chronic exposure to chlorine may cause erosion of the teeth. Multiple exposures to chlorine have produced flu-like symptoms and a high risk of developing reactive airways dysfunction syndrome (RADS). Chlorine exposure may result in chronic inflammation of the large airways (bronchitis). Chlorine gas is highly soluble in water; therefore, it is severely irritating on contact with moist tissues, such as the eyes, skin, nose, throat, and upper respiratory tract. At low concentrations, chlorine can cause eye and nose irritation, sore throat, and cough. At high exposure levels, irritation of the upper respiratory tract

Chlorine	
	and accumulation of fluid in the lungs (pulmonary oedema) contribute to a sensation of choking. Suffocation is the characteristic initial complaint of people exposed to chlorine.
Source	Cooling tower dosing – approx. 1% solution Chlorine Plant
Exposure Standard	TWA (8hr) 3 mg/m3 (peak limitation) (refer to CS Energy health monitoring schedule)
Health Effects	Skin and eye irritant Pulmonary oedema Olfactory fatigue Corrosion of tooth enamel Chronic bronchitis
Monitoring Requirements	Chlorguard system on Chlorine cylinders in service
Control Methods	**Substitution/Elimination** Removal of chlorine from site **Engineering** Automated dosing **Administration** Servicing and inspection – maintenance program Access and egress Monitoring – records ChemAlert – SDS Signage **PPE** Coveralls Splash proof goggles Gloves Respirator – Type B or air-line respirator

11.2.5 Community Acquired Infectious Diseases

Community Acquired Infectious Diseases	
Overview	Specific infectious diseases prevalent in the community which are responsible for normally self-limiting short-term illness of either the gastrointestinal or respiratory tract. Sources may include bacteria (*L. pneumophila, P. aeruginosa*), viruses (*Adenovirus*, *Norovirus, Influenzavirus A, COVID*), protozoa (*Cryptosporidium spp.*). The most susceptible people include the elderly, smokers, and those on immunosuppressive therapy, individuals with chronic obstructive pulmonary disease (COPD), organ transplant patients, and people taking corticosteroid therapy. It is important to emphasize that relatively healthy individuals can also be at risk of contracting disease. With communal food preparation areas and bathroom facilities, there is a potential for some transmission. The most common pathway for transmission of viral diseases in workplaces is through direct contact, where contact with contaminated surfaces or agents (fomites) by hands leads to the transmission of infectious agents.
Source	Contact with ill co-workers, contaminated food, clothing, utensils and furniture.
Exposure Standard	N/A
Health Effects	Gastrointestinal communicable disease Respiratory communicable disease
Monitoring Requirements	N/A
Control Methods	**Substitution/Elimination**

Community Acquired Infectious Diseases	
	Sick people to stay at home **Engineering** **Administration** Hygiene practices – hand washing Cleaning contract – communal areas Fridge cleaning Flu shots – health promotion Education – toolbox talks First aid facilities **PPE** Gloves e.g. food preparation

11.2.6 Crystalline Silica

Crystalline Silica	
Overview	Silica is silicon dioxide, a naturally occurring widely abundant mineral that forms the major component of most rocks and soils. There are non-crystalline and crystalline forms of silicon dioxide. Crystalline silica is also known as free silica. Crystalline silica dust particles which are small enough to penetrate deep into the lung are termed respirable. Respirable crystalline silica may cause lung damage. The coal supplied to Callide PS is from the Callide Coal Measures. This deposit is described in the Queensland Government Mining Journal as “Late Triassic, very sub-hydrous, with heterogeneous distributions of iron and phosphorus and low silica ash. A sub-bituminous rank that is feedstock for Callide power station; one of the lowest energy commercially exploited coals in Australia”. The coal supplied to Kogan Creek PS is from the Walloon Coal Measures of Middle Jurassic age. This consists of two coal seam horizons: The Upper group (seams K, M, N, and O) —11.5m average thickness; the Lower group (seams S, T and U) —3m average thickness. The Lower group is separated from the Upper group by up to 14m of strata. The coal is perhydrous, high volatile bituminous type and is comprised mainly of macerals of the vitrinite and liptinite groups. It typically has very high volatile matter content with fuel ratio generally in the range 0.9 to 1.1 and produces a high yield of gas and tar. The coal has a low to moderate ash content, and is relatively hard, with a Hardgrove Grindability Index (HGI) that generally ranges from about 30 to 40. Contaminants of interest from an occupational health perspective include the presence of crystalline silica (α-Quartz) and bituminous coal. Exposure to respirable crystalline silica is responsible for progressive fibrotic lung diseases, reductions in lung function and exercise capability. Crystalline Silica in the form of quartz or cristobalite is classified by IARC as a Group 1 carcinogen associated with an increased risk of lung cancers in humans. Acute exposure to respirable dusts can induce inflammation of the lungs, reduced lung function and lowered exercise tolerance. A rare form of rapidly progressing silicosis is associated with acute silica exposures. Silica containing dusts in Coal fired power stations are primarily from fly ash, the residue remaining from coal combustion. These dusts are primarily amorphous (non-crystalline) glassy particles with small remnants of microcrystalline quartz. The toxicity of these dusts is considerably lower than freshly generated crystalline silica from mining or construction activities. Epidemiological studies of coal fired power station workers have not found evidence of radiographic changes in the lung related to fly ash exposure.
Source	Fly ash, coal dust
Exposure Limit	TWA (8hr) 0.05 mg/m3 (refer to CS Energy hygiene monitoring schedule)

Crystalline Silica	
Health Effects	Carcinogen, obstructive lung disease
Monitoring Requirements	Personal dust monitoring
Control Methods	**Substitution/Elimination** Process automation **Engineering** Isolation Ventilation Enclosure and segregation Dust suppression Air conditioned cabins **Administration** Servicing and inspection – maintenance program Monitoring – records, health surveillance Incident management – INSIGHT Housekeeping ChemAlert – SDS Signage **PPE** Respiratory Protection Program – P2 respirator

11.2.7 Ergonomics

Ergonomics	
Overview	Ergonomic hazards are prevalent throughout CS Energy, ranging from prolonged static postures encountered by dozer and earthmoving plant operators, the manual operation of valves and workstation arrangements of production operators, through to hazardous manual tasks encountered by maintenance personnel. Employees on industrial sites can perform manual handling activities in awkward positions, or with their hands above their head, leading to an increased risk of ergonomic injury. Variables in assessing the likelihood of risk include the mass and size of the object, the repetitive nature of the task and task duration. Office based personnel are faced with different ergonomic hazards such as static or poor postures which may cause musculoskeletal injury and discomfort. Ergonomics is the science of designing the job, equipment and workplace to fit the worker. Proper ergonomic design is necessary to prevent musculoskeletal injuries, which can develop over time and can lead to long term disability.
Source	Operating earthmoving equipment Lowering, pushing, pulling, carrying, moving, holding or restraining an object
Exposure Limit	N/A
Health Effects	Musculoskeletal disorders
Monitoring Requirements	Hazardous Manual Task Assessments
Control Methods	**Substitution/Elimination** Risk management – eliminate ergonomic risk **Engineering** Plant and Equipment Specifications – OEM, plant modification **Administration** Task analysis, supervision Job Dictionary Hazardous Manual Task Assessments

Ergonomics	
	Medical Assessment Health Surveillance Signage **PPE** Mechanical aid
References	Hazardous Manual Tasks Code of Practice 2011

11.2.8 Fatigue

Fatigue	
Overview	Fatigue is more than feeling tired and drowsy; it is a state of mental and/or physical exhaustion that reduces a person's ability to perform work safely and effectively. Fatigue can be caused by: • prolonged or intense mental or physical activity • sleep loss or disruption of your internal body clock • long shifts • short recovery times between shifts • strenuous jobs • long commuting times • poor sleep • family demands Fatigue may increase the risk of incidents because of a lack of alertness and slower reaction times. It can also affect the ability to make good decisions.
Source	Hours of work/shift work, eye fatigue e.g. lighting, sleep disorders, travel, prescribed medication, drugs and alcohol, situation and lifestyle issues, noise.
Exposure Standard	N/A
Health Effects	Reduced decision making ability. Injury due to poor decision making.
Monitoring Requirements	Personal monitoring and awareness Fatigue Observation Record and Fatigue Assessment Form Drug and alcohol testing – random
Control Methods	**Substitution/Elimination** Nil options **Engineering** Nil options **Administration** Job rotation, job planning Supervision Observation record and Fatigue Assessment Mentoring, coaching and education Drug and/or alcohol testing Contractor Management Overhaul planning Journey Management EAP **PPE**

11.2.9 Hand Arm Vibration

Hand Arm Vibration	
Overview	Hand Arm Vibration (HAV) is vibration transmitted to the hand and arm when using hand-held power tools and hand-guided machinery like powered lawn-mowers and while holding materials being processed by machines. HAV is commonly experienced by people who use jack-hammers, chainsaws, grinders, drills, riveters and impact wrenches. Hand-arm vibration syndrome (HAVS) is a form of Raynaud's phenomenon in which spasm of the digital arteries leads to damage to the nerves, vessels, bones, and joints of the hands and fingers. Early symptoms are blanching and cyanosis of the fingers aggravated by cold. Attacks last from 15 minutes to 2 hours and are reversible after discontinuing exposure. This cumulative trauma injury occurs in workers with at least 2000 hours and usually over 8000 hours of exposure to vibration from hand tools in the range of 15-1500 Hz, but especially in the range of 125-300 Hz. The latent interval from first exposure to onset of blanching varies from 1 month to 30 years. From the initial episodes of blanching, the worker may later develop sensory and motor disturbances with impairment of fine motor skills, frequent attacks affecting all fingers, and finally trophic changes of the fingertips.
Source	Lawnmower, whipper snipper, angle grinder, hammer drill, chainsaws
Exposure Limit	No specific limits are set for Australia however, recommendations from Safe Work Australia are to adopt the values contained within Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002. r.m.s Acceleration A(8) EAV 2.5m/s² , ELV 5.0m/s² (campaign style exposure assessment – refer to CS Energy hygiene monitoring schedule)
Health Effects	Disrupted circulation Damage to nerves resulting in tingling and numbness Damage to tendons, muscles, bones and joints Carpal tunnel syndrome Vibration white finger Progressive neurological disorder
Monitoring Requirements	Campaign style exposure assessment – hand arm vibration monitor
Control Methods	**Substitution/Elimination** Replace vibrating plant (if possible) Substitute high vibration tools with lower vibration emission levels **Engineering** Isolating or cushioning **Administration** Minimise how long workers use high vibration tools **PPE** Gloves
References	Safe Work Australia – Guide to managing risks of exposure to hand arm vibration Safe Work Australia – Information sheet – hand arm vibration Safe Work Australia – Guide to measuring assessing hand arm vibration Code of Practice - Managing risks of plant in the workplace

11.2.10 Hazardous Substances (other)

Hazardous Substances (other)	
Overview	Hazardous substances are chemicals and other substances that can affect your health, causing illness or disease. They may be solvents, pesticides, paints, adhesives, petroleum products, heavy metals or any other substance that is hazardous to health and is used or produced at work. Hazardous substances can take many forms - liquids, solids, vapours, gases, fumes or dusts. To be classified as a hazardous substance, the

Hazardous Substances (other)	
	ingredients of the substance must be present in concentrations that are known to cause health effects. For some hazardous substances, exposure standards have been set. These apply where a substance is a contaminant in workplace air - for example as a dust, fume or gas. Where an exposure standard exists for a particular substance, the concentration of that substance in the air at work must be kept below the prescribed level. A number of miscellaneous hazardous substances, typically in small quantities are present on CS Energy sites. These are normally used for minor maintenance tasks and present a negligible risk under normal use conditions. This is primarily due to their moderate toxicity, small quantities, small doses or infrequent use.
Source	Tasks requiring the use of chemicals Chemicals produced at the workplace
Exposure Standard	Varied – refer to ChemAlert SDS report for individual chemicals (refer to CS Energy hygiene monitoring schedule)
Health Effects	Varies with causative agent; however, commonly irritants, central nervous system effects, systemic organ effects
Monitoring Requirements	Various exposure monitoring methods depending on hazardous substance – refer to ChemAlert SDS
Control Methods	**Substitution/Elimination** Risk assessment – substitution with less hazardous chemicals **Engineering** Isolation and Lockout Process Automation **Administration** Refer to ChemAlert – SDS Chemical Approval process – Chemical Coordinator Hazardous Substances register Job planning Risk assessment – JSEA, 2x2 Hazardous Substance audits **PPE** Various – refer to SDS for individual chemical
References	Managing Risks of Hazardous Chemicals in the Workplace Code of Practice 2013

11.2.11 Herbicides

Herbicides	
Overview	The term herbicides in this assessment refers to the chemicals Gylphosate and Picloram, used in the products Roundup® and Tordon® respectively. Both of these substances exhibit low human acute toxicity with the reported effects being localised irritation of skin and eyes. Tordon® is typically present in an alkaline solution which can cause skin burns following prolonged contact, it does not cause sensitisation and exhibits low chronic toxicity.
Source	Destroy unwanted vegetation
Exposure Limit	N/A
Health Effects	Skin and eye irritation, rash and dermatitis
Monitoring Requirements	N/A – acute illness or injury
Control Methods	**Substitution/Elimination** **Engineering** Ventilation – if required

Herbicides	
	Administration Storage Risk management ChemAlert – SDS Chemical approval – Chemical Coordinator **PPE** Splash proof goggles PVC or rubber gloves Coveralls Type A Class P1 respirator

11.2.12 Hexavalent Chromium

Hexavalent Chromium (CrVI)	
Overview	Hexavalent chromium is a form of the metallic element chromium. Chromium compounds, such as hexavalent chromium, are widely used in electroplating, stainless steel production, leather tanning, textile manufacturing, and wood preservation.. Hexavalent chromium compounds are a group of chemicals that have useful properties, such as corrosion resistance, durability, and hardness. Occupational exposures occur mainly among workers who handle chromate-containing pigments, spray paints, or coatings; operate chrome plating baths; or weld or cut metals that contain chromium, such as stainless steel. In the power industry, the following **three concurrent parameters** are required for Hexavalent Chromium to occur based on current industry knowledge: 1. **Calcium** based product is present (e.g. Calcium Based Anti-seize, potential calcium in Fly ash and/or water etc.) 2. **High temperatures** (Currently believed to be > 300°C, but hexavalent chromium has been detected at temperatures lower than this) 3. **Chromium Steel** is present. This is in stainless steel and high chromium containing materials such as steam turbines, gas turbines, boilers. Hexavalent chromium exposure occurs through breathing it in, ingesting it in food or water, or direct contact with the skin. The level of exposure depends upon the dose, duration, and work being done.
Source	Boilers Turbines Welding (carbon and stainless steel)
Exposure Standard	Exposure Standard 0.05mg/m3* *this exposure standard is currently under review
Health Effects	Hexavalent chromium compounds have been shown to cause lung cancer in humans when inhaled (IARC 1). Other effects could include nasal and sinus cancers, asthma. kidney and liver damage, nasal and skin irritation and ulceration, and eye irritation and damage.
Monitoring Requirements	Personal sampling (fumes and welding); In situ detection kits (particulate and reside)
Control Methods	**Substitution/Elimination** Substitution with less hazardous chemicals that do contain or generate Cr(VI) **Engineering** Ventilation Encapsulation **Administration** Refer to ChemAlert – SDS, reporting

Hexavalent Chromium (CrVI)	
	Chemical Approval process – Chemical Coordinator Hazardous Substances register Air monitoring Wet cleaning, high efficiency particulate vacuum removal Job planning (isolate high exposure tasks) Risk assessment – JSEA, 2x2 Personal hygiene practises Eye wash and showers **PPE** Respirator (P2 or airfed helmet), gloves, eye protection
References	Managing Risks of Hazardous Chemicals in the Workplace Code of Practice 2013

11.2.13 Inhalable Dust

Inhalable Dust	
Overview	Atmospheric dust can give rise to a number of lung disorders or diseases. One of these diseases is pneumoconiosis, which is as a general term for lung diseases caused by dust inhalation. All respirated dusts must be considered harmful in some degree. Even where there may be only slight danger to the lungs, there is very likely some adverse effect on the respiratory system, particularly to asthmatics or allergy sufferers. Dust particles of size ranging from 0.001 to 0.1 mm (1 to 100 microns) pose a threat to health when they are airborne, reducing visibility, creating an uncomfortable environment (irritation of eyes, ears, nose, throat, skin) and possibly resulting in damage to the tissues of the lungs. Larger particles, 10 to 100 micrometres, are termed *inhalable*. When breathed in, inhalable particles are trapped in the upper respiratory passages. When dust-laden air is inhaled, most of the dust particles greater than 5 microns are caught in the mucus which coats the nose, sinuses, trachea and bronchi. They are moved up with the mucus towards the throat and either expectorated or swallowed. Dust particles less than 5 microns can pass into the lungs. Acute exposure to high concentrations of inorganic dusts can produce lung overload and induce inflammation of the lungs. Chronic exposure to insoluble inorganic dusts previously considered inert can contribute to chronic obstructive airways disease (COAD), or chronic obstructive pulmonary disease (COPD).
Source	Coal dust
Exposure Standard	TWA (8hr) 10 mg/m3
Health Effects	Upper respiratory tract irritant effects Chronic obstructive lung disease
Monitoring Requirements	Personal dust monitoring (refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** Process automation **Engineering** Isolation Ventilation Enclosure and segregation Dust suppression Air conditioned cabins **Administration** Servicing and inspection – maintenance program Monitoring – records, health surveillance Incident management – INSIGHT

Inhalable Dust	
	Housekeeping ChemAlert – SDS Signage **PPE** Respiratory Protection Program – P2 respirator
References	AS3640-2009 Workplace atmospheres – Method for sampling and gravimetric determination of inhalable dust

11.2.14 Ionising Radiation

Ionising Radiation	
Overview	Ionizing radiation has enough energy to cause chemical changes by breaking chemical bonds. This effect can cause damage to living tissue. Shorter wavelength ultraviolet radiation begins to have enough energy to break chemical bonds. X-ray and gamma ray radiation, which are at the upper end of the electromagnetic spectrum, have extremely high energy. It has enough energy to strip electrons from an atom or, in the case of very high-energy radiation, break up the nucleus of the atom. The process in which an electron is given enough energy to break away from an atom is called ionization. Each ionization releases energy which is absorbed by material surrounding the ionized atom. Compared to other types of radiation that may be absorbed, ionizing radiation deposits a large amount of energy into a small area. All ionizing radiation is capable, directly or indirectly, of removing electrons from most molecules. Exposure to ionising radiation can damage DNA and cause cancer. In addition, by damaging the genetic material (DNA) contained in cells of the body, ionising radiation can cause genetic mutations that can be passed on to future generations. Acute exposure to large amounts of radiation, a rare occurrence, can cause sickness in a few hours or days and death within 60 days of exposure. In extreme cases, it can cause death within a few hours of exposure.
Source	Fixed sealed source industrial radiation gauge Non-destructive testing (NDT)
Exposure Limit	The Radiation Safety Regulation 2010 prescribes; • 20 mSv/annum for radiation workers (averaged over a period of 5 consecutive calendar years) • 1 mSv/annum above background radiation for other workers
Health Effects	Carcinogen Acute tissue injury
Monitoring Requirements	Radiation survey meters
Control Methods	**Substitution/Elimination** Removal of radiation gauges form sites Substitute NDT practises without radiation **Engineering** Isolation & Lock-out **Administration** Permit to Work Radiation Gauge Monitoring Safety checks – 3 monthly, 6 monthly, annual Training – licences, RSO Approval - acquisition, supply and relocation Records – sources leakage tests, inventory and location of devices, store log, incident reports Calibration test and maintenance Storage

Ionising Radiation	
	Radiation Safety and Protection Plan PPE
References	Radiation Safety and Protection Plan – Callide, Kogan Radiation Safety Act 1999 Radiation Safety Regulation 2010

11.2.15 Isocyanates

Isocyanates	
Overview	Isocyanates are a reactive class of organic compounds commonly used in 2-part polyurethane coatings and expansion products. Isocyanates can enter the body via inhalation and skin absorption. Traditionally inhalation exposure from spray painting results in the highest exposures, however skin contact and the inhalation of vapours from mixing also pose a risk. Isocyanates are recognised as causing sensitisation in exposed individuals resulting in the development of occupational asthma. In sufficiently high concentrations in the air, isocyanates have a primary irritant effect on the respiratory tract. Workers may develop sensitisation to isocyanates, resulting in asthma like symptoms such as chest tightness, coughing, wheezing and shortness of breath. Following sensitisation, onset of these symptoms may be caused from very low exposures below the relevant occupational exposure standard. Asthmatics are more susceptible to sensitisation as well as other adverse health effects, and therefore should be screened from tasks involving isocyanates. There is evidence that for susceptible workers, recurrent exposures may result in impairment of ventilatory function. Skin contact with isocyanates results in irritation and is a major pathway in the development of sensitisation. Like respiratory sensitisation, once contracted, health effects such as skin rashes can present following very low exposures to isocyanates.
Source	Chemicals e.g. repair kits, adhesives, sealants, paints, electrical cleaning substances
Exposure Standard	TWA (8hr) 0.02 mg/m³ STEL (15 minute) 0.07 mg/m³
Health Effects	Respiratory sensitiser Asthma Skin sensitiser Headache, loss of consciousness, coma
Monitoring Requirements	Medical examination at 6 weeks and then at 6 monthly intervals during continued exposure. The medical examination includes; • physical examination for work-related dermatitis • standardised respiratory function tests. A registered medical practitioner may choose to assess isocyanate exposure by a urinary isocyanate metabolite level test.
Control Methods	Substitution/Elimination Remove products containing isocyanates Engineering Ventilation Enclosure/segregation Administration ChemAlert – SDS Baseline monitoring before starting work with isocyanates Chemical approval – Chemical Coordinator Servicing and inspection – maintenance program Monitoring – records, health surveillance

Isocyanates	
	Incident management – INSIGHT Housekeeping Signage/labelling PPE Nitrile or neoprene gloves Splash proof goggles Type A respirator

11.2.16 Lighting

Lighting	
Overview	The simplest interpretation of providing lighting to a visual task is to provide 'light' i.e. illuminance. Illuminance is the not the only solution to a lighting problem. While the provision of sufficient illuminance on the task is a necessary element, in many instances task visibility depends heavily on the way in which the light is applied. Critical factors are the luminance contrast of the task and luminance adaptation level of the observer. Creation of the comfortable visual conditions which people require to maintain efficiency over a period of time depends on factors such as the distribution of light throughout the space; the use of suitable colours and finishes on relevant reflecting surfaces; the choice of luminaires with adequate glare control; and the elimination of unwanted reflection. These factors produce 'good quality lighting'. Experience has shown that when inefficiency, eye fatigue, spoilt work or accidents are blamed on the lighting system, failure to meet one or more of the 'quality' recommendations is often a significant part of the problem.
Source	Natural lighting Artificial lighting
Exposure Standard	N/A
Health Effects	Eye strain, headache
Monitoring Requirements	Lighting survey (in line with AS1680 - Interior and workplace lighting) (refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** Perform tasks in daylight hours if precision is required and artificial light is not suitable **Engineering** Lighting maintenance program **Administration** Lighting survey – records Defect management Housekeeping Supervision Job planning Lighting plants, additional lighting **PPE** Clean safety glasses

11.2.17 Mould

Mould	
Overview	Mould is part of a group of very common organisms called fungi that also include mushrooms and yeast. It is present virtually everywhere, both indoors and outdoors. Mould may grow indoors in wet or moist areas lacking adequate ventilation, including walls/ wallpaper, ceilings, bathroom tiles, carpets (especially those with jute backing), insulation material and wood. If moisture accumulates in a building mould growth will often occur. Many different types of mould exist and all have the potential to cause health problems. Moulds growth may result in greater numbers of spores, cell fragments, allergens, mycotoxins, endotoxins, β-glucans and volatile organic compounds in indoor air. The

Mould	
	causative agents of adverse health effects have not been identified conclusively, but an excess level of any of these agents in the indoor environment is a potential health hazard. Microbial growth requires: • Moisture (direct or in air) • Nutrients (paper, cellulose, wood, dust etc) Growth is assisted by: • Darkness (limited UV light) • Limited air movement • Humidity (over 80%) and warm temperature (between 5 and 38°C) Symptoms caused by mould allergy may include: respiratory illness or asthma, watery, itchy, red eyes, chronic cough, headaches or migraines, rashes (dermatitis), tiredness, sinus problems, blocked nose, frequent sneezing.
Source	Old paper records, archives Damp, moist areas, water leaks
Exposure Standard	N/A
Health Effects	Allergic or toxic respiratory responses, neurological effects
Monitoring Requirements	Mould inspections
Control Methods	**Substitution/Elimination** **Engineering** Ventilation – cleaning air conditioning filters **Administration** Cleaning – detergents, bleach Hygiene practises – hand washing Reduce dampness Maintenance – defect management **PPE** Respirator – spores Safety glasses

11.2.18 Nitrogen Dioxide

Nitrogen Dioxide	
Overview	Nitrogen dioxide is a gas produced from combustion processes and explosive blasting. Chronic exposure can result in the development of an asthma–like condition called RADS (Reactive Airways Dysfunction Syndrome) where small air passages react (constrict and narrow) to any irritant. (chemicals, cigarette smoke, even cold air) may cause an asthma attack. Other effects from chronic exposure may include obliterative bronchiolitis where the small air passages (bronchioles) are scarred and become distorted & blocked, reducing lung function and limiting exercise ability. Acute exposure to high concentrations can result in eye irritation – stinging and watering; Throat irritation – pungent smell, stinging nose & coughing; Lung irritation – coughing, wheezing and tight chest – difficulty breathing; NO2 can trigger asthma in asthmatics. A serious condition resulting from acute exposure is delayed pulmonary oedema, a medical emergency where lungs fill with fluid.
Source	Welding (confined spaces – more concentrated)
Exposure Standard	TWA (8hr) 5.6 mg/m^3 STEL (15 minute) 9.4 mg/m^3

Nitrogen Dioxide	
Health Effects	Respiratory irritant, tissue corrosion, pulmonary oedema (may be delayed)
Monitoring Requirements	Portable gas detectors, Nitrogen dioxide monitors
Control Methods	**Substitution/Elimination** **Engineering** Ventilation Designated welding areas/booths **Administration** Risk assessment – 2x2, JSEA Trained and competent welders Supervision Chemical approval – Chemical Coordinator ChemAlert – SDS Chemical register **PPE** Welding PPE – face shield, gauntlets, boots, apron, welding particulate respirator
References	Welding Processes Code of Practice 2013

11.2.19 Noise

Noise	
Overview	The effects of exposure to noise in the work environment may cause several physiological and psychological responses. Noise can: • Cause hearing loss • Annoy and interfere with speech • Interfere with concentration and thought processes • Disturb sleep • Cause fatigue and aggression • Reduce immune response • Lead to heart attack When noise induced hearing loss occurs, the hair cells in the inner ear are damaged beyond repair. In general, exposure to noise in the work environment and non-working environment continues to rise, and, if not managed will result in occupational noise induced hearing loss (NIHL). Hearing loss is usually cumulative and increases with exposure – length of time exposed and level of noise. It is a common health problem, which can be difficult to detect as the effects build up gradually over time. Exposure to some chemical substances and some medications can also cause hearing loss or make the effects of hearing loss worse. Exposure to hand transmitted vibrations can also worsen the effects of noise on hearing.
Source	Noise emissions from plant and equipment
Exposure Standard	**WHS Regulation s56 Meaning of exposure standard for noise** (1) In this regulation, exposure standard for noise, in relation to a person, means— (a) LAeq,8h of 85 dB(A); or (b) LC,peak of 140 dB(C).
Health Effects	Progressive hearing loss
Monitoring Requirements	Personal Noise Dosimetry (refer to CS Energy hygiene monitoring schedule)
Control Methods	**Elimination**

Noise	
	Eliminate the noisy machine or process **Substitution** Substitute noisy machine or process with a quieter one Change the way the job is done (with quieter practises e.g. not hammering) **Engineering/Redesign** Plant & Equipment Specifications – operator noise exposure < 85 dB(A) (12 hour day) – separation of person through distance or from people Equipment and plant design – noise dampeners, mufflers, silencers Maintenance strategies Enclosed cabins and offices **Administration** Risk identification and assessment (risk register), control and monitoring Job rotation Health Exposure Assessment Noise Monitoring Records Plant modification – Noise Considerations Hearing Conservation Program, education and training Health Surveillance - Audiometry Signage Hearing Protection Fit Testing Education, information and training Noise maps Cost benefit analysis for noise control options Maintenance and storage of hearing protection devices **PPE** Hearing protection devices - Ear plugs
References	AS/NZS 1269.1:2005 Occupational Noise Management NOHSC:1007 (2000) National standards for occupational noise exposure Code of Practice Managing Noise and Preventing Hearing Loss at Work 2011

11.2.20 Refined Hydrocarbons

Refined Hydrocarbons	
Overview	Refined hydrocarbon based substances such as lubricating oils, fuels and greases can have either a dermal exposure or an inhalation exposure depending on their volatility. The effects of inhalation exposure may include; lethargy, headache, incoordination, decreased mental aptitude, breathlessness, nausea and vomiting. Dermal exposures can result in drying, cracking and reddening of the skin resulting in dermatitis, the severity of which is dependent on the duration and individual susceptibility.
Source	Coatings, lubricants (oils, fuels and greases) and sealants
Exposure Standard	Diesel fuel 100mg/m3 Benzene 3.2 mg/m3
Health Effects	Central nervous system effects, dermatological effects
Monitoring Requirements	(refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** **Engineering** Isolation Ventilation **Administration** Risk assessment – 2x2, JSEA

Refined Hydrocarbons	
	Supervision Chemical approval – Chemical Coordinator ChemAlert – SDS Chemical register **PPE** Splash proof goggles Nitrile gloves

11.2.21 Respirable Dust

Respirable Dust	
Overview	Dusts are airborne solid particles. Dust is generated during grinding, crushing or chipping of hard materials or from the mechanical dispersion of fine powders. If particles are sufficiently small that they may be breathed in and reach the narrowest airways of the lung, they are termed respirable. Respirable particles are generally smaller than 10 micrometres. (One micrometre is one millionth of a metre). Occupational exposure to respirable coal dust is responsible for the development of progressive lung disease, reductions in lung function and exercise capability. The disease most commonly associated with excessive exposure to respirable coal dust is Coal Workers pneumoconiosis (CWP). This is characterised by the radiographic appearance of small (1-2mm) discreet opacities in the lung. People with this condition are at increased risk of developing Progressive Massive Fibrosis (PMF), characterised by the presence of larger dark opacities with damage to surrounding structures of the lung. The development of PMF is associated with significant impairment of ventilatory capacity and hypoxaemia on exertion. Patients with PMF are at significant risk of premature mortality. There is evidence that long-term exposure to many dusts previously considered inert can contribute to chronic obstructive airways disease (COAD), or chronic obstructive pulmonary disease (COPD).
Source	Coal dust
Exposure Standard	TWA (8hr) 2.5mg/m3
Health Effects	Respiratory Irritation (Dust) Occupational Asthma Coal Workers Pneumoconiosis (Coal Dust and Quartz) Progressive Massive Fibrosis (Dust) Chronic Obstructive Airways Disease (Dust)
Monitoring Requirements	Personal dust monitoring (refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** Process automation **Engineering** Isolation Ventilation Enclosure and segregation Dust suppression Air-conditioned cabins **Administration** Servicing and inspection – maintenance program Monitoring – records, health surveillance Incident management – INSIGHT Housekeeping

Respirable Dust	
	ChemAlert – SDS Signage **PPE** Respiratory Protection – P2 or P3 respirators, airfed helmets
Reference	AS2985-2009 Workplace atmospheres – Method for sampling and gravimetric determination of respirable dust

11.2.22 Sulphuric Acid and Mist

Sulphuric Acid and Mist	
Overview	IARC have classified mists containing strong inorganic acids as Group 1 - carcinogenic to humans. There is sufficient evidence in humans for the carcinogenicity of mists from strong inorganic acids to cause cancer of the larynx. Non-cancer effects associated with chronic exposure to sulphuric acid are chronic cough and dental erosion. Acute exposure to acid mists is irritating to mucous membranes of the eyes, nose and respiratory tract. Localised pain, oedema and tissue damage is present, there may be difficulty breathing due to bronchospasm.
Source	Bulk tank storage – diluted for use in Demineralisation Plant Cooling Towers – maintain PH levels
Exposure Standard	TWA (8hr) 1 mg/m³ STEL 3mg/m³
Health Effects	Skin, eye and respiratory system irritant, possible burns Respiratory tract cancer, acute tissue damage
Monitoring Requirements	(refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** Eliminate use of sulphuric acid **Engineering** Ventilation **Administration** ChemAlert – SDS Storage Chemical Approval process – Chemical Coordinator Risk Management **PPE** Splash proof goggles PVC or rubber gloves Coveralls Type B respirator

11.2.23 Synthetic Mineral Fibres

Synthetic Mineral Fibres	
Overview	Dust from glasswool and rockwool products may cause irritation, tickling and dryness of the nose, throat and respiratory tract, especially for those who suffer hay fever, asthma or bronchitis. The most noticeable effect from exposure to SMF is temporary skin irritation, particularly where there is rubbing from clothing such as cuffs and collars; and irritation to eyes and mucous membranes if exposure is significant. IARC have classified SMFs as; • Glasswool - Category 3 - not classifiable as carcinogenic to humans • Rockwool - Category 3 - not classifiable as carcinogenic to humans

Synthetic Mineral Fibres	
	• Refractory Ceramic Fibres (high temperature applications) classified as Category 2B - possibly carcinogenic to humans. Since 2000 – 2002, all glass and rockwool insulation products manufactured in Australia have been biosoluble, allowing the product to dissolve in bodily fluids and be quickly cleared from the lungs.
Source	Insulation materials (electrical, insulation batts)
Exposure Standard	TWA 0.5 f/ml (high biopersistent fibres only) TWA 2 mg/m^3 for all fibre types
Health Effects	Irritation of skin and mucous membranes
Monitoring Requirements	Air sampling (refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** Remove products containing SMFs **Engineering** Isolation **Administration** Personal hygiene Air sampling ChemAlert –SDS Housekeeping - cleaning Storage Risk assessment – JSEA **PPE** Respirator (?) Safety goggles Gloves

11.2.24 Thermal Stress

Thermal Stress	
Overview	The thermal environment can have a significant effect on people. Most commonly seen as acute exposures, heat can produce a spectrum of effects dependent on exposure: • Heat rashes are tiny red spots on the skin which cause a prickling sensation during heat exposure. • Heat cramps are sharp pains in the muscles that may occur alone or be combined with one of the other heat stress disorders. • Heat exhaustion consisting of symptoms including: heavy sweating, weakness, dizziness, intense thirst, nausea, headache, vomiting, diarrhoea, muscle cramps, breathlessness, palpitations, tingling and numbness of the hands and feet. • Heat syncope is heat-induced dizziness and fainting induced by temporarily insufficient flow of blood to the brain while a person is standing. • Heat stroke is the most serious type of heat illness. Signs of heat stroke include body temperature often greater than 41°C, and complete or partial loss of consciousness. Heat stress occurs when heat is absorbed from the environment faster than the body can get rid of it. Several factors may contribute to heat stress, such as the type of work activity, the surrounding air temperature/humidity level, and the physical condition of the individual. The human body maintains a fairly constant internal temperature even though it may be exposed to varying environmental temperatures. To keep internal body temperatures within safe limits in hot conditions, the body must get rid of excess heat – and it does this

Thermal Stress	
	by evaporating sweat and varying the blood flow to the skin. These responses are controlled by the brain and usually occur when the blood exceeds 37 degrees centigrade The outdoor work environment at CS Energy presents a considerable thermal stress hazard in the summer months and the nature of work makes rescheduling to cooler parts of the day difficult. The deployment of conventional heat stress controls (hydration, rest breaks, scheduling) are extremely important.
Source	Heat, sun
Exposure Standard	N/A
Health Effects	Acute thermoregulatory injury, heat stress, heat exhaustion, heat stroke
Monitoring Requirements	Temperature monitoring – determine thermal work limit (TWL)
Control Methods	**Substitution/Elimination** Removal of heat source – heat generating equipment Rotate tasks outside hotter times in the day Don't work in the direct sunlight **Engineering** Install heat shields Cool air conditioning **Administration** Cool drinking water Risk assessments – 2x2, JSEA, Basic heat stress risk assessment Acclimatisation Hydration testing **PPE** Sun shades, sunscreen Hard hat brims Provide shaded areas

11.2.25 Ultraviolet (UV) Radiation

Ultraviolet (UV) Radiation	
Overview	Solar radiation is a known occupational carcinogen (for outdoor workers) associated with increased risk for malignant melanoma and other skin cancers. The Australian population has the highest rate of skin cancer in the world. There is growing evidence that sun exposure later in life continues to add to the risk of developing melanoma. The incidence of melanoma increases with age much more in men after 40–50 years of age and it is more than double in men than in women after 70 years of age. There is a 1 in 14 risk of being diagnosed with invasive melanoma by age 85. Workers >40 years old are at higher risk than younger workers. Acute exposure to UV radiation can also cause photokeratoconjunctivitis (welder's flash), cataracts, skin burns, and both photo irritant and photo allergic contact dermatitis (PICD and PACD).
Source	Working outdoors, direct sun Welder's flash
Exposure Standard	N/A
Health Effects	Skin cancer, acute skin burns, cataracts
Monitoring Requirements	Campaign style exposure assessment
Control Methods	**Substitution/Elimination** Rotate tasks outside hotter times in the day Don't work in the direct sunlight **Engineering**

Ultraviolet (UV) Radiation	
	Administration Bureau of Meteorology – UV intensity Regular skin checks Education and awareness **PPE** Sun shades, sunscreen Hard hat brims Provide shaded areas

11.2.26 Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOCs)	
Overview	Volatile Organic Compounds (VOCs) are a large group of carbon-based chemicals that easily evaporate at room temperature, they are commonly encountered in solvents, adhesives and coatings. Some common examples include Acetone, Trichloroethylene, Solvent Naphthas, and Xylenes. Common short-term symptoms of exposure to VOCs include: eye, nose and throat irritation, headaches, nausea and dizziness. Long-Term effects of high levels of VOCs may increase the risk of cancer, liver, kidney and central nervous system damage.
Source	Penetr8 (corrosion protection) Lanotec (welding) Moulds can release VOCs Electrical cleaning substances
Exposure Standard	Varies (depending on the compound)
Health Effects	Central nervous system effects, systemic organ effects
Monitoring Requirements	(refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** **Engineering** Segregation of tasks **Administration** Personal hygiene Air sampling ChemAlert –SDS Housekeeping - cleaning Storage Risk assessment – JSEA **PPE** Splash proof goggles Nitrile or neoprene gloves

11.2.27 Welding and Metal Fumes

Welding and Metal Fumes	
Overview	There are about 20 major types of welding processes used on 10 major classes of materials, and hence an extremely wide range of work environments are possible. MMAW and GMAW are the two most common types of welding used. In general, the five combinations MMAW/mild steel, MMAW/stainless steel, GMAW/mild steel, GMAW/stainless steel and GMAW/aluminium account for 60 to 70 per cent of all welding activity. Acute exposure to freshly generated welding fumes can produce effects similar to influenza lasting 24-48 hours. Metal fume fever is usually linked to welding or hot work on galvanised metals. High exposures to mild steel weld fume can also cause this illness. Metal fume fever does not usually have any lasting ill effects.

Welding and Metal Fumes	
	Gases and fine particles in welding fume can cause dryness of the throat, tickling, coughing or a tight chest. The effects tend to be short lived. Ozone is a particular cause of this when GTAW welding stainless steels and aluminium. High exposures to nitrous oxides (generated during most arc welding operations) can also cause this health effect. Welding fume is internationally classified as possibly carcinogenic to humans (IARC classification group 2B). Although primarily associated with stainless steel welding, this classification is not limited to stainless steel fume. Overall lung capacity and peak flow are affected by prolonged exposure to welding fume. The effects tend to get worse through the working week but gradually improve when not exposed. In addition to welding fume and gases other toxic fumes, smoke and gases may be evolved by heating paint, plastics and other metal coatings during welding or hot work. Acute poisoning due to excess exposure or severe short term exposure to one or more welding fumes or gases has been documented. However, other than lung involvement, that is, mainly respiratory irritation and related effects, few chronic, long term effects have been directly attributed to welding fumes and gases. Due to the presence of chromium, nickel and aluminium, there is concern about the effects of chronic exposure on special groups such as welders of stainless steel and aluminium.
Source	Welding activities and welding materials e.g. electrodes
Exposure Standard	TWA 1mg/m^3 *Individual metals and gases depending on the type of welding, the welding consumable and the parent metal
Health Effects	Varies depending upon type of welding and consumables used; however, commonly acute febrile Illness, chronic bronchitis, cough
Monitoring Requirements	Campaign style exposure assessment (refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** **Engineering** Ventilation Designated welding areas, booths **Administration** ChemAlert – SDS Chemical approval – Chemical Coordinator Personal hygiene Air sampling Housekeeping - cleaning Storage Risk assessment – JSEA **PPE** Welding PPE – face shield, gauntlets, boots, apron, welding particulate respirator
References	Welding Processes Code of Practice 2013

11.2.28 Whole Body Vibration

Whole Body Vibration	
Overview	Vibration arises from various mechanical sources with which humans have physical contact. Vibration energy can be passed on to operators from vehicles on rough roads; vibrating machinery; or vibrating work platforms and may give rise to adverse health effects. It can be transmitted through the feet and legs and commonly through the buttocks while seated in a vehicle. The magnitude of the effect of vibration depends on the severity and length of exposures. Whole body vibration (WBV) is the mechanical vibration that when transmitted to the whole body can result in low-back morbidity and trauma of the spine. Studies of long-term exposure to WBV show evidence of risks to health, mainly musculoskeletal

Whole Body Vibration	
	disorders involving the lower spine, neck and shoulders. High WBV exposure increases the risk of lower-back pain, herniated discs and early degeneration of the spine. Whole body vibration encountered in earthmoving equipment can constitute a significant exposure, dependent on the nature of the ground, speed and vehicle characteristics.
Source	Earthmoving equipment, forklift operation Mill. Noisy areas
Exposure Standard	No specific limits are set for Australia however, recommendations from Safe Work Australia are to adopt the values contained within Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002. • r.m.s. Acceleration EAV 0.5m/s² ELV 1.15m/s² • VDV EAV 9.1 m/s$^{1.75}$ ELV 21 m/s$^{1.75}$
Health Effects	Progressive neurological and orthopaedic disorder
Monitoring Requirements	Campaign style exposure assessment – (refer to CS Energy hygiene monitoring schedule)
Control Methods	**Substitution/Elimination** Replace/substitute vibrating plant (if possible) Substitute high vibration tools with lower vibration emission levels **Engineering** Isolating, dampening or cushioning Provision and maintenance of plant **Administration** Minimise how long workers use high vibration equipment, on vibrating plant **PPE** Suitable boots
References	Safe Work Australia – Information sheet – whole body vibration Safe Work Australia – Guide to measuring assessing whole body vibration Safe Work Australia – Guide to managing risks of exposure to whole body vibration AS2670 Evaluation of human exposure to whole body vibration • AS 2670.1-2001 (No change from original above) • EN 14253:2003: Mechanical vibration Code of Practice - Managing risks of plant in the workplace