NSW GOVERNMENT

NSW Resources Regulator

PLANNED INSPECTION PROGRAM

CONSOLIDATED REPORT: AIR QUALITY OR DUST OR OTHER AIRBORNE CONTAMINANTS – SURFACE AND UNDERGROUND METALLIFEROUS MINES

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Contents

Executive summary

A crucial part of the NSW Resources Regulator's Incident Prevention Strategy involves targeted assessment and planned inspection programs for mines and petroleum sites. This is a focus on assessing an operation's control of critical risks through evaluating the effectiveness of control measures in the mine's safety management system. To this end, the Regulator developed a bowtie hazard management framework and standardised assessment checklist for each program plan. Under each program plan, the effectiveness of the safety management system at each mine site is assessed against a standard set of control supports and critical controls. This final report summarises assessment findings from 44 mines in relation to assessments for the principal hazard of air quality or dust or other airborne contaminants conducted during the period from July 2020 to November 2020. The threats and critical controls assessed for the material unwanted event, exposure to hazardous atmosphere, are shown in Table 1. Note that not all mines were assessed for all critical controls.

Table 1. Threats, Consequences and Critical Controls for the Material Unwanted Event - Exposure to hazardous atmosphere

THREAT/CONSEQUENCE		CRITICAL CONTROL
Threat	1. Low oxygen environment 2. Dust raised into suspension 3. Hazardous chemicals in the atmosphere 4. Carcinogens in the atmosphere 5. Conditions conducive to biological agents	PC 1.1 – Minimise airborne contaminants
Threat	1. Low oxygen environment 2. Dust raised into suspension 3. Hazardous chemicals in the atmosphere 4. Carcinogens in the atmosphere	PC 1.3 – Ventilate workplace PC 1.4 – Separate workers
Threat	2. Dust raised into suspension	PC 2.3 – Dust containment and extraction
Consequence	One or more fatalities	MC 1.2 – Hygiene monitoring MC 1.3 – Health monitoring

Legislative requirements and published guidance relating to the principal hazard of air quality or dust or other airborne contaminants is listed in Appendix A. Figure 1 presents safety compliance findings for each de-identified mine and critical control assessed for the material unwanted event – exposure to hazardous atmosphere. Explanatory notes on the assessment system are also listed in Appendix B.

Key findings

Some of the key findings for this planned inspection program of air quality or dust or other airborne contaminants included:

- Documentation supporting this principal hazard was generally in place and incorporated the relevant controls used on site. However, there were some mines that had not reviewed their associated documents to ensure they were current.
- Health and hygiene monitoring was conducted well by most mines, with the onset of COVID-19 initially delaying on-going health surveillance. Hygiene monitoring was often done for both dust and diesel particulates on a regular basis.
- Worker knowledge of the overall principal hazard was to a sufficient standard. An adequate understanding of the health effects of dust and other airborne contaminants was demonstrated by most workers.
- In minimising airborne dust, effective controls implemented included water sprays, extraction systems and covered product conveying systems.
- Ventilation at underground mines was found to be lacking somewhat and is an area where improvements are required. This was primarily around devices used to control ventilation which were not adequately installed or maintained.
- Cleanliness of control rooms and mobile plant cabins was poor, however the maintenance of supporting systems, such as air conditioners, filters, door seals and window seals, was performed adequately.

Recommendations

While the majority of sites displayed an adequate management of this principal hazard, there are a number of areas which need to be considered to ensure airborne contaminants remain a focus for all mines and that continuous improvement is constantly being sought.

The following recommendations are made:

- All related documentation should be reviewed to ensure current controls remain effective and any new controls are appropriately evaluated, assessed, documented and implemented.
- Review all information, training and instruction for workers and ensure all workers are provided with the necessary knowledge to best understand the health effects of dust including the prescribed dust exposure standards. This should include:
  - Fit testing of masks and respirators is carried out by a reputable company
  - cleaning of rooms/mobile plant cabins is ideally done using a vacuum cleaner fitted with a high efficiency particulate arrestance (HEPA) filter to capture very fine dust particles
  - where a suitable vacuum cleaner is unavailable and a dustpan/brush is used, appropriate personal protective equipment is worn while doing this work.
- Equipment such as water sprays, fogging systems, dust extraction and collection units are aligned to a regular maintenance schedule and are set up to automatically initiate when dust is generated, rather than relying on the discretion of workers, such as control room operators.
- Gases and other chemicals should be stored correctly and appropriately segregated, as per material safety data sheets.
- All hygiene monitoring results should be analysed in a timely manner. Mines should have a threshold below the exposure standard which is the baseline for the contaminant being measured. Where results exceed the site's threshold, an internal investigation should be undertaken to determine the reason for the elevated results. Controls may then need to be reviewed for effectiveness.

Introduction

The NSW Resources Regulator's planned assessment programs provide a planned, risk-based and proactive approach to assessing how effective an operation is when it comes to controlling critical risk. These programs apply the following principles that:

- focus on managing prescribed 'principal hazards' from the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014
- evaluate the effectiveness of control measures implemented through an organisation's safety management system
- consider the operation's risk profile.

The objective of risk profiling is to identify the inherent hazards and the hazard burden that exist at individual operations in each mining sector in NSW. The information is then used to develop the operational assessment and inspection plans that inform the program.

Scope

Planned inspection programs include two assessment types:

- Targeted assessments, incorporating:
  - desktop assessment of:
    - compliance against legislation with respect to the management of health and safety risks associated with air quality or dust or other airborne contaminants – see Appendix A for details
    - the definition of the controls the mine utilises to prevent and mitigate the risks to health and safety associated with air quality or dust or other airborne contaminants
  - a workplace assessment of the implementation of those controls through the inspection of plant and worker interviews
- Planned assessments, which involve a workplace assessment of the implementation of controls through the inspection of plant and worker interviews only.

The process

The process for undertaking an assessment under a planned inspection program generally involves several stages that include:

- preliminary team meetings, preparation and review of documents
- execution of an on-site assessment, involving:
  - an on-site desktop assessment of relevant plans and processes measuring legislative compliance of the relevant plans (targeted assessments only)
  - the inspection of relevant site operations (both targeted assessments and planned inspections).
- discussion and feedback to the mine management team on the findings and actions that need to be taken by the mine operator in response.

Assessment findings

Controls assessed

Threats for critical control PC1.1

1. Low oxygen environment
2. Dust raised into suspension
3. Hazardous chemicals in the atmosphere
4. Carcinogens in the atmosphere
5. Conditions conducive to biological agents

- **Critical control:** PC 1.1 – Minimise airborne contaminants
- **Control objective:** Limit the creation of airborne contaminants at the source
- **Performance requirement**
  1. Contaminants capable of posing an airborne exposure hazard are identified
  2. Controls are implemented to minimise the creation of contaminants capable of posing an exposure hazard

Over half of the mines assessed demonstrated full compliance, while a small percentage demonstrated an inadequate understanding of this critical control. At the minority of sites, it was evident that work was still required to minimise airborne contaminants, mainly associated with dust and gases, as well as chemical storage and separation.

Dust minimisation through suppression was one of the main elements assessed in this critical control. Inspectors found good examples of working installations, however there were instances in high dust areas where water spraying/misting were either non-existent, not functioning, not maintained or inadequately understood by workers.

The other areas of dust creation were trafficable roads which included the regular use of mobile plant. The prevailing environmental conditions were also a factor in these areas and it was generally found that water carts were available and used to good effect.

Other findings with regards to this critical control included the following:

- In general, documentation associated with airborne containments such as risk assessments, Principal Hazard Management Plans and Trigger Action Response Plans were available but, in some cases, were found to be either not relevant, outdated or not easily accessible by workers.
- Potential sources of dust, mainly around spillage from conveyors, had not been identified or had not been managed appropriately.
- An inadequate standard for the storage, segregation and separation of hazardous substances that potentially could have resulted in the production of harmful gases.

Threats for critical controls PC1.3 and PC1.4

1. Low oxygen environment
2. Dust raised into suspension
3. Hazardous chemicals in the atmosphere
4. Carcinogens in the atmosphere

- **Critical control:** PC1.3 Ventilate workplace
- **Control objective:** Dilute airborne contaminant levels to as low as reasonably practicable or direct them away from the breathing zone of people in the workplace
- **Performance requirement**

    1. Ventilation is identified as a means of reducing the risk of people being exposed to poor air quality, dust or other airborne contaminants
    2. The nominated ventilation systems effectively maintain air quality or reduce dust and airborne contaminants exposure to as low as reasonably practicable

This critical control was mainly associated with underground mines where ventilation of underground workings was assessed. A very small number of underground mines did not manage this critical control adequately.

Open cut mines and quarries were assessed for this critical control differently, whereby confined spaces and welding bays, for example, were areas inspected. In general, confined spaces and welding bays ventilation management consisted of forced or extracted air through mechanical means.

A large portion of mines produced evidence to suggest that ventilation was being managed adequately. Installations were effective, maintained and worker knowledge of the systems was satisfactory.

Some of the shortcomings however were associated with the following:

- Documentation, such as risk assessments, Principal Control Plans and Trigger Action Response Plans (TARPS) were either irrelevant, outdated or not easily accessible.
- Ventilation devices such as stoppings, regulators, and other commonly used equipment were either incorrectly installed and/or positioned, not adequately maintained, and in some instances, not available in the required location.

- **Critical control:** PC1.4 – Separate workers
- **Control objective:** Physical barriers protect people from being exposed to airborne contaminants or air quality that exceeds exposure limits
- **Performance requirement**

    1. Physical barriers are identified as a means of separating people from poor air quality, dust or other airborne contaminants.
    2. Installed physical barriers effectively separate people from poor air quality, dust or other airborne contaminants.

The vast majority of mines had practical systems in place to manage this critical control, with a small number showing an inadequate approach.

Separation barriers were largely around doors to enclosed crusher buildings/control rooms or to enclosed cabins on mobile plant. These were found to be effective and regular maintenance of air conditioners, filtration systems, door seals and window seals was routinely conducted. Control room and cabin cleanliness through vacuuming/sweeping and wiping of surfaces were also integral to good hygiene. However, this was performed less effectively because:

- a vacuum cleaner without a HEPA filter was used, resulting in very fine respirable particles being disturbed and not being captured
- when sweeping or using a dustpan/brush, fine dust was stirred up and appropriate PPE was not worn.

Worker's knowledge of the hazard, as with other critical controls assessed, remains an area for ongoing improvement. Consideration should be given to Clause 104 of WHS (MPS) Regulation 2014 which refers to the duty to provide information, training and instruction.

Threat for critical control PC2.3

1. Dust raised into suspension

- **Critical control:** PC 2.3 – Dust containment and extraction
- **Control objective:** Airborne dust is contained within a process or extracted and collected to prevent people being exposed
- **Performance requirement**

    1. Dust containment and extraction is identified as a means of protecting people from airborne dust
    2. Dust containment and extraction controls are implemented to minimise airborne dust
    3. Contained or extracted dust is disposed of in a manner that minimises release into the atmosphere

The majority of mines performed well in this area where extraction or exhaust systems were installed. The product was either extracted, contained and disposed of, or exhausted via available means. There was good use of extraction systems in combination with sprays/misting devices to minimise airborne dust. There were some instances where spray/misting systems were effectively used and consideration had not been given to the installation of an extraction system. Mine operators demonstrated a willingness to explore all options, especially where the free silica content of mined material was high.

Our awareness campaign on the revised exposure standards for respirable dust and respirable crystalline silica in airborne contaminants appears to have prompted several mine operators to reassess their own dust controls, particularly with regards to extraction in such areas.

Some areas of improvement existed around the maintenance of installations as they were either not working or operating effectively. Specifically, in relation to sprinkler systems, some mine operators relied on a worker's judgement (such as the control room operator) to manually turn on spray systems when dust levels rose significantly. However, there were occasions witnessed when sprays and sprinklers should have been activated, but were not, due to an oversight from the control room operator. Mine operators should consider automating this action where reasonably practicable.

Consequences for critical controls MC1.2 and MC1.3

1. One or more fatalities

- **Critical control:** MC1.2 Hygiene monitoring
- **Control objective:** Worker exposure to airborne contaminants is monitored to confirm control effectiveness and to gather data to drive improvement activity
- **Performance requirement**

    1. Hygiene monitoring is identified as a means of monitoring worker exposure to poor air quality, dust or other airborne contaminants
    2. Worker exposure to poor air quality, dust or airborne contaminant is monitored

A significant number of operations had mature and effective systems in place to monitor airborne contaminants. This was primarily for dust, and to a lesser extent, diesel exhaust emissions in underground mines. Results showed good levels of personal monitoring and static monitoring.

The increased uptake of hygiene monitoring aligns with recommendations made by our airborne dust awareness campaign, particularly with regards to the potentially fatal health effects of silicosis, if not monitored appropriately.

There were areas highlighted for improvement and mainly focussed around a lack of suitable analysis of monitoring results, insufficient worker knowledge of the hazard, and failure to update associated documents with the revised exposure standards. In a few cases, workers had also not been provided with their individual monitoring results.

- **Critical control:** MC1.3 Health monitoring
- **Control objective:** Early indication of health impacts caused by exposure to poor air quality, dust or airborne contaminants are identified
- **Performance requirement**

    1. Health monitoring is identified as a means of detecting early changes to workers health as a result of exposure to poor air quality, dust or other airborne contaminants.
    2. Workers participate in a health monitoring program.

The majority of mines had an effective system in place to monitor the health of workers, through initial pre-employment medicals and a risk-based monitoring program that was structured on the type of work they were required to do. The onset of COVID-19 disrupted many mine's health monitoring schedules and delayed ongoing testing as a result.

Workers were generally confident of the health monitoring systems in place at their respective mines and demonstrated a strong knowledge of elements contained within the associated documents.

Findings by mine

Figures 1 -3 present aggregate assessment findings by critical control, providing a summary view of the status of each mine's hazard management processes. Importantly, the system recognises the value of fully implemented and documented controls by awarding an additional point if both elements were assessed as present. More details explaining the assessment system are found at Appendix B.

Figure 1. Assessment findings for the planned inspection program air quality or dust or other airborne contaminants – Surface and underground metalliferous mines – overall results <65%

Mine	Threat				Consequence	
	1. Low oxygen, 2. Dust, 3. Toxic or corrosive chemicals, 4. Carcinogens, 5. Biological agents	1. Low oxygen, 2. Dust, 3. Toxic or corrosive chemicals, 4. Carcinogens		Dust raised into suspension	One or more fatalities	
	PC1.1	PC1.3	PC1.4	PC2.3	MC1.2	MC1.3
	Minimise airborne contaminants	Ventilate workplace	Separate workers	Dust containment and extraction	Hygiene monitoring	Health monitoring
Mine A	Green	Not applicable	Green	Green	Not applicable	Not applicable
Mine B	Not applicable	Orange	Not applicable	Not applicable	Green	Green
Mine C	Red	Red	Red	Red	Green	Red
Mine D	Not applicable	Green	Not applicable	Not applicable	Green	Green
Mine E	Not applicable	Yellow	Not applicable	Not applicable	Green	Green
Mine F	Orange	Not applicable	Red	Orange	Not applicable	Not applicable
Mine G	Green	Not applicable	Green	Not applicable	Not applicable	Not applicable
Mine H	Red	Not applicable	Orange	Green	Not applicable	Not applicable
Mine I	Yellow	Not applicable	Yellow	Yellow	Not applicable	Not applicable
Mine J	Green	Not applicable	Green	Green	Not applicable	Not applicable

Green (=100%)
Yellow (>= 80% and <100%)
Orange (>= 65% and <80%)
Red (<65%)
Not applicable

Figure 2. Assessment findings for the planned inspection program air quality or dust or other airborne contaminants – Surface and underground metalliferous mines – overall results ≥65% and <95%

Mine	Threat				Consequence	
	1. Low oxygen, 2. Dust, 3. Toxic or corrosive chemicals, 4. Carcinogens, 5. Biological agents	1. Low oxygen, 2. Dust, 3. Toxic or corrosive chemicals, 4. Carcinogens		Dust raised into suspension	One or more fatalities	
	PC1.1	PC1.3	PC1.4	PC2.3	MC1.2	MC1.3
	Minimise airborne contaminants	Ventilate workplace	Separate workers	Dust containment and extraction	Hygiene monitoring	Health monitoring
Mine K	Green	Yellow	Red	Red	Green	Green
Mine L	Green	Green	Red	Red	Red	Green
Mine M	Yellow	Orange	Yellow	Red	Green	Green
Mine N	Orange	Orange	Not applicable	Yellow	Yellow	Green
Mine O	Green	Red	Green	Green	Red	Green
Mine P	Orange	Orange	Orange	Green	Green	Green
Mine Q	Orange	Orange	Yellow	Orange	Green	Green
Mine R	Orange	Orange	Yellow	Green	Red	Green
Mine S	Red	Not applicable	Green	Not applicable	Green	Green
Mine T	Green	Red	Green	Green	Green	Green
Mine U	Green	Green	Yellow	Yellow	Red	Green
Mine V	Green	Not applicable	Green	Green	Red	Green
Mine W	Yellow	Green	Green	Orange	Not applicable	Not applicable
Mine X	Green	Yellow	Green	Orange	Green	Green
Mine Y	Yellow	Not applicable	Yellow	Green	Yellow	Green

Green (=100%)
Yellow (>= 80% and <100%)
Orange (>= 65% and <80%)
Red (<65%)
Not applicable

Figure 3. Assessment findings for the planned inspection program air quality or dust or other airborne contaminants – Surface and underground metalliferous mines – overall results ≥95%

	Threat				Consequence	
	1. Low oxygen, 2. Dust, 3. Toxic or corrosive chemicals, 4. Carcinogens, 5. Biological agents	1. Low oxygen, 2. Dust, 3. Toxic or corrosive chemicals, 4. Carcinogens		Dust raised into suspension	One or more fatalities	
	PC1.1	PC1.3	PC1.4	PC2.3	MC1.2	MC1.3
Mine	Minimise airborne contaminants	Ventilate workplace	Separate workers	Dust containment and extraction	Hygiene monitoring	Health monitoring
Mine Z						
Mine AA						
Mine AB						
Mine AC						
Mine AD						
Mine AE						
Mine AF						
Mine AG						
Mine AH						
Mine AI						
Mine AJ						
Mine AK						
Mine AL						
Mine AM						
Mine AN						
Mine AO						
Mine AP						
Mine AQ						
Mine AR						

Green (=100%)
Yellow (>= 80% and <100%)
Orange (>= 65% and <80%)
Red (<65%)
Not applicable

Notices issued

Of the 44 sites assessed under the inspection program, 37 separate mines received notices relating to the principal hazard of air quality or dust or other airborne contaminants, while some mines received notices in relation to other matters. For the purposes of this report, contraventions related to other matters have been removed from the analysis. The notices issued for air quality or dust or other airborne contaminants were examined in detail and Table 2 below lists the notices issued by type and details.

Table 2. Notices issued for the planned inspection program for air quality or dust or other airborne contaminants – Surface and underground metalliferous mines

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES
s.195 prohibition notice	3	3
s.191 improvement notice	38	24
s.23 notice of concerns	46	31
Total	87	37

Of the combined 87 notices issued, there were some common themes which were apparent throughout the program plan. Table 3 summarises the type of contraventions and outlines the total occurrences encountered. These themes can be related back to the critical controls outlined earlier and identify some trends which are of concern.

Table 3. Notices issued - prevalence of categories of concern

IDENTIFIED CONCERN CATEGORY	TOTAL OCCURRENCES IN NOTICES
Equipment used to remove or suppress airborne containments is not readily available, maintained appropriately or inadequate	24
Documentation relating to controls for airborne containments (i.e. risk assessment, PHMP, TARPs) not relevant, current, or readily available	15
Training workers on the selection, use, and fitting of PPE deficient	12
Documentation relating to controls for ventilation (i.e. risk assessment, PCP, TARPs, air quantity, flow rates, plans) not relevant, current, or readily available	9
Missed opportunity to analyse monitoring results	8
Dust sources (i.e. spillage, poor housekeeping, conveying, transit) not identified or managed	8
Poor standard of storage or separation of hazardous substances that could result in the production of harmful gas contaminating the air	6
Poor standard of verifying compliance to nominated controls on site	6
Ventilation devices (i.e. stoppings, overcast/undercast, regulators, doors, air locks, brattice/vent tubing, booster fans, water sprays, scrubbers) inappropriately installed, positioned, maintained, available, or hazardous to use	6
Workers observed to be non-compliant with the nominated controls on site	6
Information for workers not clearly communicated or detailed in relation to hazard monitoring	5

IDENTIFIED CONCERN CATEGORY	TOTAL OCCURRENCES IN NOTICES
Dust enclosures (i.e transfer points, seals) is not readily available, maintained, fit for purpose or located appropriately	5
Workers not familiar with exposure standards or risk to health	4
Documentation relating to controls for health plans (i.e. risk assessment, PCP, TARPs) not relevant, current, or readily available	3
Workers not familiar with nominated controls on site	3
Inspection and removal/minimising hazard(s) (airborne containments) before commencing work not completed, inadequate, or ignored	3

Further information

For more information on safety assessment programs, the findings outlined in this report, or other mine safety information, please contact the NSW Resources Regulator.

CONTACT TYPE	CONTACT DETAILS
Email	cau@planning.nsw.gov.au
Incident reporting	To report an incident or injury call 1300 814 609 or log in to the Regulator Portal
Website	www.resourcesregulator.nsw.gov.au
Address	NSW Resources Regulator 516 High Street Maitland NSW 2320

Appendix A. Legislative requirements and published guidance relating to the principal hazard of air quality or dust or other airborne contaminants

The following is a list of certain legislative requirements for the management of air quality or dust or other airborne contaminants risks referred to in this report as provided by the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 and Work Health and Safety Regulation 2017.

Work Health and Safety (Mines and Petroleum Sites) Regulation 2014

- Clause 9 – Management of risks to health and safety
- Clause 26 (3) - Health control plan
- Clause 39 – Ensuring exposure standards for dust not exceeded
- Clause 54 – Air quality – airborne contaminants (Underground mines)
- Clause 103 - 108 – Information, training and instruction
- Schedule 1, Part 2, Clause 5 – Air quality or dust or other airborne contaminants
- Schedule 2, Clause 1 - Health control plan

Work Health and Safety Regulation 2017

- Clause 36 - Hierarchy of control measures
- Clause 49 - Ensuring exposure standards for substances and mixtures not exceeded
- Clause 50 - Monitoring airborne contaminants levels
- Clause 51 - Managing risks to health and safety (Safe oxygen level)
- Chapter 7, Part 7.1 – Hazardous Chemicals
- Chapter 7, Part 7.2 – Lead

Appendix B. Assessment system explained

We use a bowtie framework to proactively assess how mine sites manage their principal hazards. Bowties are a widely used risk management tool that integrates preventative and mitigating controls onto threat lines that relate to a material unwanted event.

As part of program planning, controls were categorised in accordance with the ICMM handbook. Only controls deemed critical[1] are assessed under a planned inspection program. For a control to be assessed as effective, each of its control supports must be in place and operational.

Assessment findings results calculation

During the program, each control support assessed at each mine was rated and the findings recorded. Points were awarded depending on whether there was evidence that the control support had been documented and / or implemented. Importantly, the system recognises the value of fully implemented and documented controls by allocating four points if both these elements were present.

For finding outcomes, points were awarded for each control support identified within a critical control. An overall assessment result for the critical control was then calculated as a proportion of the maximum possible points for that critical control. For example, if a critical control comprises ten control supports and five were assessed as fully implemented (‘documented and implemented’) and five were found to be ‘not documented and not implemented’ then the overall assessment result for that critical control would be 50%.

Table 3. Finding outcome and points

FINDING OUTCOME	POINTS
Documented and implemented	4
Implemented but not documented	2
Documented but not implemented	1
Not documented and not implemented	0

Critical control calculations also took into account instances where control supports were not applicable to the mine being assessed or when control supports were not able to be assessed during a site visit.

[1] Critical Control Management Implementation Guide, International Council on Mining and Metals (ICMM), 2015.

The overall assessment result for each critical control has been assigned a colour based on the assessment bands presented in the table below. The colour band results are then used to identify industry focus areas requiring improvement.

Table 4. Assessment results and colour code

CRITERIA	COLOUR
An assessment result of 100% of possible points	Green
An assessment result of ≥ 80% but < 100% of possible points	Yellow
An assessment result of ≥ 65% but < 80% of possible points	Orange
An assessment result of < 65% of possible points	Red