NSW GOVERNMENT

NSW Resources Regulator

PLANNED INSPECTION PROGRAM

CONSOLIDATED REPORT: AIR QUALITY OR DUST OR OTHER AIRBORNE CONTAMINANTS – STAGE 2 – COAL MINES ABOVE SURFACE

December 2020 – October 2021

NSW Resources Regulator

Document control

Published by NSW Resources Regulator

Title: Air quality or dust or other airborne contaminants – Stage 2 – Coal mines above surface

Published: July 2022

Authorised by: Chief Inspector of Mines, NSW Resources Regulator

CM9 reference: MEG/DOC21/967597

AMENDMENT SCHEDULE		
Date	Version	Amendment
July 2022	1.0	First published

Contents

Executive summary 4
Key findings 5
Recommendations 5
Introduction 7
Scope 7
The process 8
Assessment findings 8
Controls assessed 8
Threats for critical control PC1.1 8
Threats for critical controls PC1.4 10
Threat for critical control PC2.3 11
Findings by mine 12
Notices issued 14
Further information 17
Appendix A. Legislative requirements and published guidance relating to the principal hazard of air quality or dust or other airborne contaminants 18
Appendix B. Assessment system explained 20
Assessment findings results calculation 20

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.

The Regulator has developed a bowtie hazard management framework and standardised an 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.

Because of the various controls derived from the bowtie analysis for the principal hazard of air quality or dust or other airborne contaminants within the open cut coal industry, the overall program plan was split into two stages. This report summarises the assessment findings from stage two of the program, which covered 36 mines between December 2020 and October 2021.

For stage two of the program, the threats and critical controls assessed for the material unwanted event, exposure to hazardous atmosphere, are shown in Table 1.

Table 1. Threats and critical controls assessed 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 1.4 – Separate workers
Threat	2. Dust raised into suspension	PC 2.3 – Dust containment and extraction

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:

- Some sites were actively pursuing best practice controls and monitoring equipment to ensure exposure to airborne contaminants was minimised
- Live monitoring of dust sampling was in place at a few sites to assist in identifying and mitigating risk to exposure areas
- Heavy equipment cabin seal testing with ultrasonics and cabin pressure sensors/monitoring was installed and part of the operator's checks at some sites
- Some maintenance technicians were using filtered, air-fed helmets to control welding fumes
- Workers at some sites had difficulty identifying the range of airborne contaminant hazards in their workplace, the health impacts of exposure to those hazards and the controls and action required of them when controls were ineffective
- Workers were able to recall the likely airborne contaminants and their health effects
- Follow up on surface stage 1 assessments and consolidated report for PC 1.3 Ventilate workplace, MC 1.2 Hygiene monitoring, and MC 1.3 Health monitoring was not complete at some sites
- A sand blasting crew at one surface operation had not ensured all documentation was completed and required controls were in place before starting the task.

Recommendations

The following recommendations are made:

- When updating their risk assessments and principal hazard management plans and procedures, mine operators should ensure there is alignment and consistency across all required controls
- Mine operators should ensure that shut-down criteria for airborne contaminant prevention on large mobile plant is clearly documented, communicated to workers for daily use, and reinforced through supervision control verification.
    - Operators should ensure that periodic refresher training includes the duties and obligations of workers to escalate safety issues and follow-up through their supervisors
    - Risk assessments and supporting documents should include risk mitigation of all likely airborne contaminants - including but not limited to gases and vapours, low oxygen, dust

(including crystalline silica), diesel particulates or other carcinogens, hazardous chemicals, asbestos, volatile organic compounds, welding fumes and biological agents

- Specific regions of strata should be identified that contain higher concentrations of hazardous particles such as silica
- Welding fume extraction systems should be introduced to site and maintained in accordance with the site's maintenance management system based on original equipment manufacturer (OEM) recommendations
- Mine operators, workers and maintenance contractors should consult to ensure that hot work permits contain guidance to manage the risk of airborne contaminants such as when mechanical ventilation, additional RPE and exclusion zones are required
- Mitigation of the risk of carcinogenic effects of diesel and welding fumes should be consistent with air contaminants risk assessments, principal hazard management plans, the mechanical engineering control plan, ventilation and filtration procedures for hot work and diesel management on site.

It is recommended that mine operators review their site's relevant risk assessments, principal hazard management plans and associated documents to manage the risks pertinent to airborne contaminants. During the review process, mine operators are encouraged to consider the above recommendations, as well as comments in Table 3 below and the guidance published within Appendix A.

Introduction

The 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 and site safety health representatives 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

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

- In general, inspector's assessments of controls to ensure that airborne contaminants were both minimised and controlled at their source found that 20% of surface operations (including CHPPs) had not fully documented and implemented effective controls. Though many of the workers interviewed were able to summarise airborne contaminants at their workplace, ongoing refresher training will help to ensure that efforts to educate and inform their workers about health effects, actions required of them and industry trends are reinforced. Many sites have developed interactive educational programs for this purpose
- Supervisory oversight of some mobile crushing plants was lacking, resulting in site standards for dust suppression not being applied or maintained
- Large equipment operators were somewhat diligent in ensuring regular cabin cleanliness to reduce dust build-up, yet there was still room for significant improvement to ensure risks to health and safety are both mitigated and minimised.
- Some sites had unsealed roads or stockpiling areas near warehousing and stores areas but had not risk assessed airborne contaminants or implemented appropriate controls.
- Some workers could not adequately explain the range of airborne contaminant hazards in their workplace, the health impacts of exposure to those hazards, the controls and action required of them when controls were ineffective.

Threats for critical controls PC1.4

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

- **Critical control:** PC1.4 – 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 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.

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

- Numerous large equipment suppliers have soundly implemented standards and equipment for the prevention of airborne contaminants in operator cabins, however, some sites have seal integrity and positive pressure air conditioning listed on operator inspection sheets as a Category 3 (lower order) defect, allowing equipment to continue operating
- Cabin positive pressure monitoring and alarms were in place at some sites to verify door seal integrity
- Although workers at most sites stand down equipment if airborne contaminants mitigating controls were faulty, pre-use checklists do not always include required actions
- Some mines had a regular practice of proactively exploring improvement opportunities to reduce airborne contaminants
- Not all workers understood what to look for when assessing the adequacy of cabin seals
- The standards for quality filtration of the air entering operator's cabins on large equipment were variable and dependant on the site's proactivity.

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

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

- Areas assessed for dust containment and extraction included workshops, welding bays, tipping and loading activities, conveyor transfers and mobile crushing plant. While most mines' documentation and implementation ranked well, the main areas of concern identified during the Stage 2 assessments were poor control of fumes and treatment of extracted particulates at some welding bays and effective monitoring and control of dust at mobile crushing plant
- Hot work permits did not always provide guidance to manage the risks from airborne contaminants when ventilation was required, or when higher levels of RPE or exclusion zones were required
- While some sites rarely had recorded exposures under their health monitoring plan, not all sites maintained a leading practice outlook across all work groups, worksites and project initiatives to ensure effective implementation of preventative and mitigating controls.

Findings by mine

Figures 1 -3 present aggregate assessment findings by critical control, providing a summary 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 in Appendix B.

Figure 1. Assessment findings for the planned inspection program air quality or dust or other airborne contaminants – stage 2 – coal mines above surface – overall results <100%

Mine	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	1. Low oxygen environment, 2. Dust raised into suspension, 3. Hazardous chemicals in the atmosphere, 4. Carcinogens in the atmosphere	2. Dust raised into suspension
	PC1.1	PC1.4	PC2.3
	Minimise airborne contaminants	Separate workers	Dust containment and extraction
Mine A	Red	Red	Red
Mine B	Orange	Orange	Orange
Mine C	Green	Yellow	Red
Mine D	Yellow	Green	Yellow
Mine E	Yellow	Green	Yellow
Mine F	Orange	Green	Green
Mine G	Yellow	Green	Green
Mine H	Green	Green	Yellow
Mine I	Green	Green	Yellow

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 – stage 2 – coal mines above surface – overall results =100%

Mine	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	1. Low oxygen environment, 2. Dust raised into suspension, 3. Hazardous chemicals in the atmosphere, 4. Carcinogens in the atmosphere	2. Dust raised into suspension
	PC1.1	PC1.4	PC2.3
	Minimise airborne contaminants	Separate workers	Dust containment and extraction
Mine J	●	●	●
Mine K	●	●	●
Mine L	●	●	●
Mine M	●	●	●
Mine N	●	●	●
Mine O	●	●	●
Mine P	●	●	●
Mine Q	●	●	●
Mine R	●	●	●
Mine S	●	●	●
Mine T	●	●	●
Mine U	●	●	●
Mine V	●	●	●
Mine W	●	●	●
Mine X	●	●	●
Mine Y	●	●	●
Mine Z	●	●	●
Mine AA	●	●	●
Mine AB	●	●	●
Mine AC	●	●	●
Mine AD	●	●	●
Mine AE	●	●	●
Mine AF	●	●	●
Mine AG	●	●	●
Mine AH	●	●	●
Mine AI	●	●	●
Mine AJ	●	●	●

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

Notices issued

Of the 36 sites assessed under the inspection program, 17 separate mines were given notices relating to the principal hazard of air quality or dust or other airborne contaminants. Some mines were given notices in relation to other matters. For the purposes of this report, contraventions of other matters were removed from the analysis. The notices issued for air quality or dust or other airborne contaminants were examined in detail and Table 2 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 – stage 2 – coal mines above surface

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES
s.195 prohibition notice	-	-
s.191 improvement notice	15	10
s.23 notice of concerns	15	13
Total	**30**	**17**

Of the combined 30 notices issued, there were some common themes that 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 that were of concern.

Table 3. Notices issued - prevalence of categories of concern

IDENTIFIED CONCERN CATEGORY
Controls identified in risk assessments and principal hazard management plans were not always followed up with control verification activities and monitoring by supervisors.
Some sites had soundly documented controls in their CHPP and workshop areas that were not backed up by regular housekeeping and maintenance.
Dust extraction and filtration from welding and hot works areas was not always considered, installed or maintained effectively under the hierarchy of controls.
In some cases, additional RPE including forced air helmets was used where ventilation at surface areas was insufficient. Ventilation requirements should be assessed and documented under the hierarchy of controls.
Not all matters identified in the stage 1 Air quality or dust or other airborne contaminants consolidated report for open cut coal, July 2021 (July-November 2020) was actioned or closed out.
Regular refresher training and verification of competency was warranted about the actions required of workers if their systems or equipment were defective and unable to fully protect them from all airborne contaminants. This should include actions required to escalate concerns through pre-start check, defect management and safety management systems, through their supervisor or open cut examiner (OCE).
Technical information and industry guidance materials for control and management of welding fumes was not fully adopted across surface coal mines and coal preparation plans (refer to Appendix A).
Visual educational aids like those in NSW Environment Protection Authority – Dust Assessment Handbook (2019) were not available to some workers and supervisors. Development of such tools for supervisors and workers would assist reduce dust exposures. (This concise handbook was prepared by the NSW Environment Protection Authority (EPA) in consultation with the mining industry and the Department of Planning, Industry and Environment).
Filter replacement frequency was not consistently specified across surface operations for battery powered personal RPE (used by some welders and workers in confined spaces), vacuum cleaners

IDENTIFIED CONCERN CATEGORY
(used by some large equipment operators) and large mobile equipment operator cabins (such as HEPA filtration).
Operators of surface mine sites and coal preparation plants should ensure alignment between their airborne contaminants risk assessments, principal hazard management plans, hot works arrangements and control verification procedures.

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@regional.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. In addition, several guidance documents are also noted that have been published and are available for industry distribution.

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

- Clause 26 (3) - Health control plan
- Clause 39 – Ensuring exposure standards for dust not exceeded
- Clause 86 - Sampling and analysis of airborne dust (Coal mines)
- 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 Act 2011

- Sections 27 to 29 – Duty of officers, workers and others

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)

Other guidance and materials:

- Diesel particulate monitoring – AIOH Diesel Particulate Matter & Occupational Health Issues, Position Paper
- Welding – SafeWork NSW Code of Practice Welding Processes, Weld Australia Guidance Note TGN-SW01 - Fume Minimisation Guidelines, NOHSC Guide - Welding Fumes and Gases, SWA_model_code_of_practice_welding_processes_2020, NSW Resources Regulator Safety Bulletin SB18-17, Welding fume safety - Welding processes declared a carcinogen, NSW Resources Regulator Safety Bulletin – Welding Fume Extraction Fans, 2021 - fume management equipment in hot work areas at mine sites and processing plants.
- Airborne Dust – AIOH Coal-Mining-Open-Cut-Silica-and-Coal-Dust-V2; NSW Environment Protection Authority - Dust Assessment Handbook (2019)

Learning from disasters event:

- Re-emergence of dust diseases including coal miner's pneumoconiosis and silicosis in the mining industry.

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 International Council on Mining and Metals 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 documented, in place and operationally compliant.

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 was 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

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

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.

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