NSW Resources Regulator

TARGETED ASSESSMENT PROGRAM

Consolidated report – Worker exposure to respirable dust, NSW underground coal mines

Final report - October 2017

NSW GOVERNMENT | Planning & Environment Resources Regulator

Document control

Published by NSW Department of Planning and Environment, NSW Resources Regulator

Title: Consolidated report – Respirable dust

First published: October, 2017

Authorised by: Chief Inspector of Mines

RM8 reference: PUB17/734

Amendment schedule		
Date	Version	Amendment

Contents

Executive summary

This report summarises the findings of the targeted assessment program in relation to the hazard of worker exposure to respirable dust in underground coal mines. Assessments were undertaken at 15 mines in the period October 2016 to August 2017.

The targeted assessment is an in-depth look at the control measures for the management of worker exposure to respirable dust and their implementation. The assessments are undertaken by a multi-disciplined team of Resources Regulator inspectors using both desktop and on-site assessment.

During this program, mine operators were assessed for compliance to legislation in force at the time of the assessment, including the Work Health and Safety Regulation 2011. References to that Regulation are made in this report. It should be noted that the Regulation was repealed on 31 August 2017, and replaced by the Work Health and Safety Regulation 2017, which commenced on 1 September 2017.

The findings of the assessments are grouped into those that are specific to the principal hazard of worker exposure to respirable dust, and those that could be generally applied to all aspects of critical control measure implementation.

The assessment program identified that at many sites there were opportunities to improve the effectiveness of principal hazard management plans, procedures and trigger action response plans (TARPs).

In particular, procedures did not always mandate the use of personal protection equipment (PPE) and/or respiratory protective equipment (RPE), even though the assessment teams observed worker use of PPE was widespread.

Another common issue was the failure to involve an appropriate cross-section of workers exposed to the hazard in risk assessments.

Targeted assessments are seen as a valuable process and a powerful analytical tool capable of identifying critical risk control issues not previously uncovered by conventional inspection regimes.

Background

The targeted assessment program (TAP) provides a planned, intelligence-driven and proactive approach to assessing how effective an operation is when it comes to controlling critical risk. The TAPs apply the following principles:

- A focus on managing prescribed 'principal hazards' from the Work Health and Safety (Mines and Petroleum Sites) [WHS (M&PS)] Regulation.
- Evaluation of the effectiveness of control measures implemented through an organisation's safety management system.
- Consideration of the operation's risk profile and the targeting of operations deemed to be highest risk.

The objective of the risk profiling is to identify the inherent hazards and the hazard burdens 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.

Each TAP is undertaken by a team of inspectors from various disciplines, such as electrical and mechanical engineering, who work together with the operation's management team to undertake a thorough assessment of the control measures associated with the relevant hazard and their implementation.

Scope

Involving a multidisciplinary team of inspectors, the scope of the targeted assessment included two elements:

- A desktop assessment of:
    - compliance against legislation with respect to worker exposure to respirable dust.
    - controls the mine utilises to prevent and mitigate worker exposure to respirable dust.
    - means the mine utilise to monitor the effectiveness of those controls.
- A workplace assessment of the implementation of those controls.

The process

The process for undertaking a TAP generally involves the following stages:

1. Preliminary team meetings and the preparation of documents.

2. Information and assessment requirements are discussed and supplied to the relevant mine.

3. Execution of a two-day on-site assessment involving:
    - a site desktop assessment of all relevant plans and processes
    - a discussion with the mine management team on the legislative compliance of the relevant plans
    - the inspection of relevant site operations.

4. Discussion and feedback to the mine management team on the findings and actions that need to be taken by the operators in response.

Worker exposure to respirable dust

Airborne contaminants are generated during coal mining activities such as extraction, drilling, crushing, hauling and stockpiling of coal and other rock containing minerals. Workers in coal mines may be exposed to both coal dust and crystalline silica.

In NSW mines, the operator of a mine or petroleum site must, so far as is reasonably practicable, minimise the exposure of persons at the mine or petroleum site to dust and must ensure that no person is exposed to eight-hour, time-weighted average atmospheric concentrations[1] or airborne dust that exceeds[2]:

- 3mg/cubic metre (or 2.5mg/cubic metre in the case of a coal mine) for respirable dust
- 10mg/cubic metre for inhalable dust.

Exposure standards for individual substances also must be met within these overall limits[3]. For example, the exposure standard for crystalline silica is 0.1 mg/m^3.

In underground coal mining, coal and crystalline silica dust occur at both an inhalable and respirable fraction. Normally dust of the larger inhalable fraction is considered an irritant as it is deposited in the upper respiratory tract. At the smaller respirable fraction, these dust contaminants represent a serious health risk to those exposed.

The smaller-sized particles can penetrate into the lower regions of the lung where gas exchange takes place. As such, coal and silica dusts at the respirable fraction can cause pneumoconiosis (in the case of coal) or silicosis (in the case of crystalline silica). Both conditions are disabling and often fatal lung diseases.[4]

Under the Work Health and Safety Act, a person conducting a business or undertaking has the primary duty to ensure, so far as is reasonably practicable, workers and other people are not exposed to health and safety risks arising from the business or undertaking. This duty includes eliminating exposure to airborne dusts, for example, by using alternative mining processes. If it is not reasonably practicable to do so, then risks must be minimised so far as is reasonably practicable.

The Work Health and Safety Regulation 2017 (WHS Regulation) prescribes exposure standards[5] for substances that must not be exceeded in respect of a person at any workplace (clause 49).

The WHS (M&PS) Regulation requires mine operators to manage risks and implement a range of control measures including:

- implementing a principal hazard management plan for air quality or dust or other airborne contaminants (clause 23-25)
- ensuring the exposure standards for respirable and inhalable dust is not exceeded (clause 39)
- implementing a ventilation control plan to ensure effective ventilation (clause 62)
- implementing air quality, monitoring and ventilation arrangements (clauses 38-42, 54-64 and 71).

Also, operators of underground coal mines must:

- undertake certain actions if air quality or safety standards are not met, such as withdrawing workers from a place of risk and preventing re-entry (clause 76)

[1] Measured in accordance with Australian Standard AS2985-2009

[2] Clause 39(1) WHS(M&PS)R

[3] Clause 49 WHSR

[4] The National Institute of Occupational Safety and Health (NIOSH)

[5] *Workplace Exposure Standards for Airborne Contaminants* published by Safe Work Australia on its website with a date of effect 18 April 2013 as in force or remade from time to time

- ensure sampling and analysis of airborne dust is carried out under, and in accordance with, a licence, and at the locations and frequency as prescribed (clause 86, part 9 and schedule 6).

Elimination and control

To reduce worker exposure to appropriate levels, more than one control measure may be required.

Control measures fall into three categories, which are minimising:

- dust generation at the source.
- dust generation throughout the work environment.
- exposure to individuals at risk.

Whatever strategy is adopted, it should be under-pinned by using the hierarchy of controls, so that occupational exposure to dust can be controlled.

The process used to extract coal is an important consideration in minimising the dust generated.

The design, implementation and operation of ventilation systems also play a critical role in minimising the risks posed by airborne contaminants.

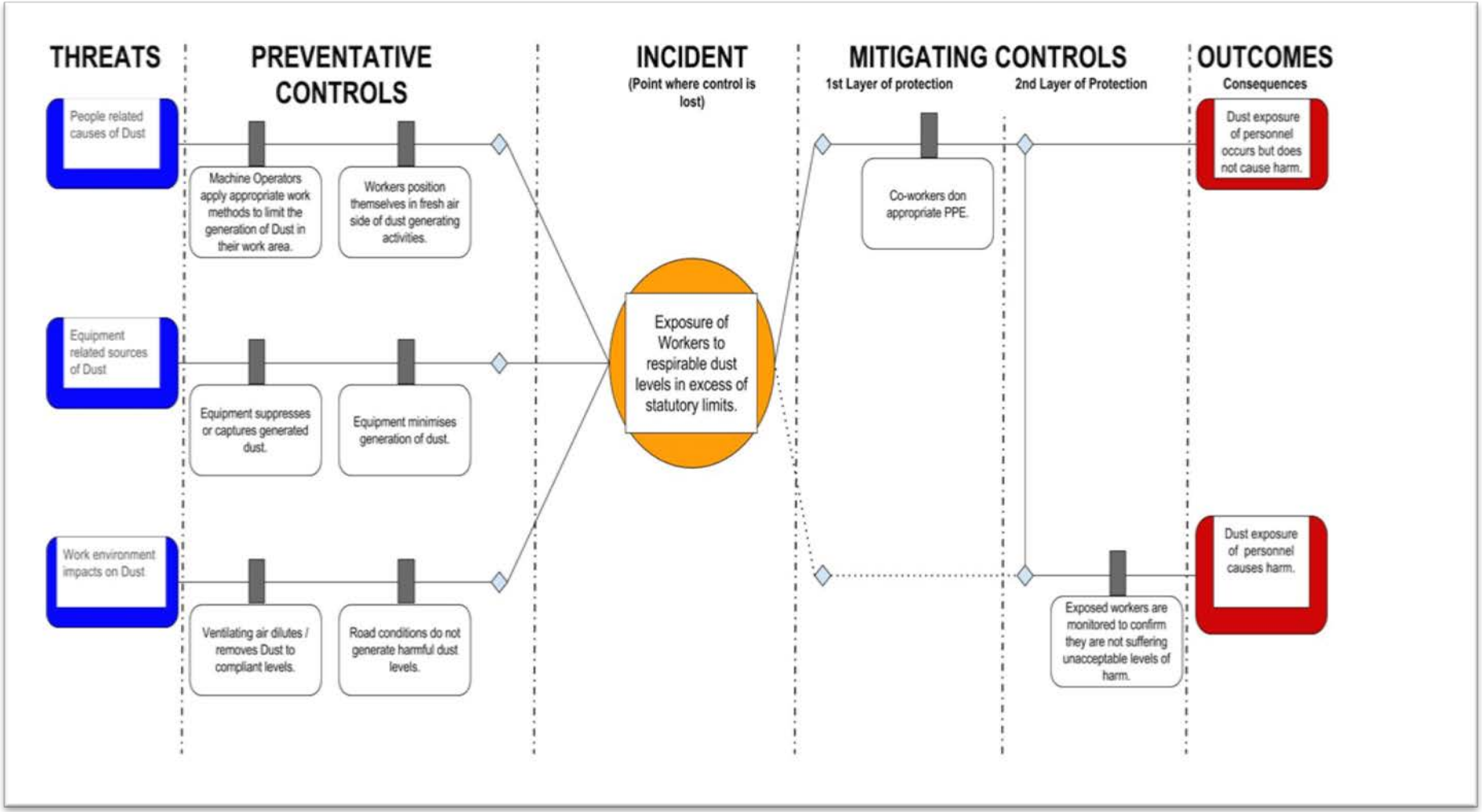
Dust suppression and separation/positioning of people by distance or barriers from the airborne contaminants generated may also prevent or minimise exposure (for example, use of remote controlled equipment).

The above methods to control workplace exposure to airborne contaminants are now readily available, as are commonly employed atmospheric monitoring and health surveillance strategies.

Bow-tie risk assessment

When developing this targeted assessment program, the Resources Regulator completed a bow-tie risk assessment of the hazard of respirable dust in underground coal mines. The bow-tie risk assessment was facilitated by appropriately qualified external facilitators, and involved both Resources Regulator inspectors, and external representatives with appropriate technical expertise.

Bow-tie risk assessment – outcome



Assessment findings

The program identified issues with the implementation of critical controls to manage the hazard, and more generally with the process of developing, reviewing and implementing controls. While the issues were not relevant at all of the sites assessed, the findings provide some valuable information that should be considered when developing critical controls.

The assessment process identified that:

- where specific procedures, triggers, and other information was included in more than one document within the safety management system, the stated information must be consistent. In particular, information must not conflict in relation to controls such as operator positioning, requirements for PPE, required ventilation quantities for specific mining tasks, and inspection and maintenance requirements for equipment that captures or suppresses dust, or is used in dust-generating activities
- procedures and standards must address the principal mining hazard of air quality or dust or other airborne contaminants, and include all mining operations and locations where airborne dust is present
- operator positioning/safe standing zones in particular were sometimes developed with a specific focus on risks associated with the hazards of gas and interaction between workers and equipment, without specific consideration or reference to the hazard of airborne dust
- appropriate consultation was not always undertaken with workers in all aspects of the development, implementation and review of the safety management system for the mine[6]. This included the process of identifying principal hazards, assessing and managing risks associated with principal hazards, and developing principal hazard management plans. In general, the assessment team considered there was insufficient consultation with workers between conducting risk assessments and the development of related principal hazard management plans.

The findings of this assessment are grouped into two categories:

- **General findings** that can be used to inform all aspects of an operation's safety management and provide valuable information and insight across all sectors and operation types.
- **Specific findings** should be used to inform and improve safety management systems to address this principal hazard.

General findings

Areas of good practice

During the program it was identified that some mines had implemented initiatives including engaging consultants and/or forming project teams to develop and trial controls. These included a longwall automation project, and development and trial of water spray types and configurations for equipment in longwall and development panels, conveyor belt systems, and for roadways.

Most mines implemented static and real-time dust sampling regimes above statutory requirements. Some mines implemented similar exposure group (SEGs) programs for some or all mining operations.

Several mines initiated dust mapping to determine the source of airborne dust, to identify areas of high levels of airborne dust, and establish a baseline for monitoring and measuring change. This has assisted mine operators to develop and monitor the effectiveness of controls including, safe standing zones/worker positioning, PPE/RPE requirements, and controls for working on the return side of dust-generating activities.

[6] Part 4, WHS (M&PS) Regulation

At most mines, workers demonstrated an appropriate level of understanding of procedures and systems relating to managing the risks associated with airborne dust, indicating training programs were effectively implemented.

Consultation

Issue	Response
Risk assessments for principal hazards did not always include consultation with workers who are likely to be directly affected by the hazard subject of the risk assessment.	The mine operator must ensure that risk assessments include participants who are likely to be directly affected by the hazard subject of the risk assessment, including operators and trades personnel where appropriate[7].
Most mines were unable to produce evidence of consultation with workers between the completion of risk assessments and the development of related principal hazard management plans.	Mine operators must consult with workers in relation to the development, implementation and review of the safety management system, including principal hazard management plans[8].

Trigger action response plans

Issue	Response
Risk assessments undertaken generally identified appropriate controls for reducing exposure to respirable dust. However, there were no TARPs in place to initiate the implementation of these controls.	Mine operators should determine the appropriate responses to foreseeable failures of dust reduction or mitigation controls and document those actions to provide clear instructions for all workers.
Mine operators did not consider the impacts of strata in determining risk controls.	TARPs should consider the impact of poor strata conditions on longwall faces, and minimise the risk of worker exposure to dust when workers are manually operating powered roof supports in these conditions.

[7] Clause 47, clause 49 WHS Act, clause 120, clause 121 WHS (M&PS) Regulation

[8] Part 4, WHS (M&PS) Regulation

Personal protective equipment

Issue	Response
Workers did not always carry or wear appropriate PPE when working in areas of the mine where respirable dust was present.	Mine operators must ensure that workers are provided with appropriate PPE[9] and are provided with information, training and instruction in the proper use of the equipment.[10] The worker must, as far as the worker is reasonably able, use or wear the PPE in accordance with the information, training or instruction provided.
Procedures did not always clearly state when the use of respiratory protection equipment is mandatory, and did not address all mining operations and locations where respirable dust is present.	Mine operators must ensure that procedures clearly identify the circumstances when wearing RPE is mandatory. The PPE procedure must address all mining operations and locations including longwall and development panels, and return airways.[11]

Requirements for principal hazard management plan

Issue	Response
The principal hazard management plan (PHMP) did not set out the reasons for adopting or rejecting each control measure considered.	In assessing risk and selecting controls to implement, the reasons for adopting or rejecting controls to manage principal mining hazards must be documented in the PHMP[12].
The PHMP did not contain performance standards, or was not reviewed and/or audited as per legislated requirements.	Mine operators must ensure that PHMPs include performance standards and that plans are audited against the performance standards[13]. Principal hazard management plans must also include provisions for review, and as necessary revision of the plan[14].
Several mines had stated an incorrect workplace exposure standard within the PHMP in relation to respirable crystalline silica.	Mine operators must ensure that in relation to respirable crystalline silica no person at the mine is exposed to an eight-hour, time-weighted average atmospheric concentration that exceeds 0.10mg/m^3[15]

[9] Clause 36, WHS Regulation

[10] Clause 44, WHS Regulation

[11] Clause 44, WHS Regulation

[12] Clause 24(3)(i), WHS (M&PS) Regulation.

[13] Clause 15, WHS (M&PS) Regulation

[14] Clause 25, WHS (M&PS) Regulation.

[15] Clause 39, WHS (M&PS) Regulation

Document control

Issue	Response
Documents within the safety management system including management plans, work procedures, and other documents were not always consistent in relation to stated information.	Where specific procedures, requirements or other information appears in more than one document within the safety management system, mine operators must ensure that information is consistently stated. Mine operators should review management plans, work procedures and other documents to ensure that information is consistently stated in relation to RPE/PPE requirements, safe standing zones, required ventilation quantities for specific mining operations and inspection and maintenance of equipment, including triggers for replacing picks and sprays on longwall shearers and continuous miners.
Documents contained within the safety management system, including risk assessments, management plans and control plans did not always address all mining operations at mine sites.	Mine operators must establish a safety management system that provides a comprehensive and integrated system for the management of all aspects of risks to health and safety in relation to the operation of the mine.[16]

Respirable dust - specific findings

Worker positioning/safe standing zones

Issue	Response
Worker positioning/safe standing zones contained in management plans and work procedures often addressed other principal mining hazards, but failed to consider the principal mining hazard of air quality or dust or other airborne contaminants appropriately.	Ensuring appropriate consultation, mine operators are required to develop documented procedures to control the positioning of workers on and around mining machinery while it is operational. The procedures must clearly address all hazards, including the risks associated with the principal mining hazard of air quality or dust or other airborne contaminants.[17] All workers potentially exposed to the hazard are to receive information, training and instruction in the procedures as appropriate.[18]
Worker positioning procedures not developed for all cutting sequences in mining operations and not identified in relevant management plans and work procedures.	When developing controls for minimising worker exposure to airborne dust, mine operators should ensure that operator positioning procedures are developed for all cutting sequences in mining operations in both longwall and development. Procedures should be documented in the PHMP, or otherwise the PHMP should directly reference documents where the specific procedures are stated.

[16] Clause 13, WHS (M&PS) Regulation

[17] Clause 5, WHS (M&PS) Regulation

[18] Clause 104, WHS (M&PS) Regulation, clause 39 WHS Regulation

Ventilation quantities

Issue	Response
Ventilation control plans (VCP) specify legislated minimum quantities for ventilation[19] but in practice some areas of the mine, for example the longwall face, require much higher minimum ventilation quantities for safe production to occur.	Mine operators must ensure the VCP accurately records the ventilation quantities required for safe production to occur, and must ensure that the ventilation system provides air that is of sufficient volume, velocity and quality to ensure that the general body of air in the areas in which people work or travel has dust levels that are as low as is reasonably practicable, and do not exceed the relevant levels specified in clause 39.[20]
Procedures relating to the use of cement products were identified as being deficient. There was no standard for ventilation of areas where cement products were being mixed or sprayed.	Procedures relating to the construction of stoppings and seals should be reviewed. Mine operators should develop a standard for ventilation where cement products are used in underground coal mines that considers the hazard of respirable dust. Work procedures should identify appropriate controls including ventilation quantities required[21], and consider whether an exclusion zone is necessary on the return side of this work.

Restricted zones

Issue	Response
Management plans did not adequately define what activities were permitted in the restricted zone and the time limits for those activities. Workers were unsure of restrictions for working on the return side of dust generating activities.	It is recommended that mine operators review procedures for when, how long and under what conditions workers can be on the return side of dust generating activities. Mine operators must ensure that workers are aware of the procedures and audit compliance with the procedures. Mine operators should carry out sampling of air in restricted zones to confirm that the time limits for exposure are appropriate.

[19] Clause 71, WHS (M&PS) Regulation

[20] Clause 55, WHS (M&PS) Regulation

[21] Clause 55, WHS (M&PS) Regulation

Dust sampling and health monitoring records

Issue	Response
Most mines incorrectly documented that worker health monitoring records and dust sampling results are kept for a period of seven years.	Mine operators must ensure that for hazards known to have a cumulative or delayed health effect, health monitoring reports for workers must be kept for least 30 years after the record is made.[22] In relation to air monitoring results, mine operators must ensure that results are recorded and kept for 30 years after the date the record is made.[23]

Where to now

Targeted assessments provide an account of the issues observed at particular sites at a particular time. Some of the findings resulted in notices being issued, including notices of concern, under section 23 of the WHS (M&PS) Act, and improvement notices, under section 191 of the WHS Act.

The matters addressed by the notices reflect the findings of the Resources Regulator inspectors.

Notice	In relation to
Improvement notices, s 191	• VCP does not identify actual quantities of air required for specific mining operations and does not address all mining operations. • A standard is required for ventilation where cement products are used. • Inadequate or no procedures for when, how long and under what conditions workers can be on the return side of dust generating activities. • Health monitoring reports of workers not kept for thirty years as required by legislation. • Safety management system documents do not address all mining operations undertaken at the mine site. • Safe standing zones/worker positioning procedures not developed for all cutting sequences for continuous miner and longwall operations; worker positioning procedures not identified in relevant plans and work procedures, and worker positioning procedures that do not address the principal hazard of respirable dust. • No documented procedure for cutting stone in first workings and no documented procedure for replacing picks and sprays on shearer cutter drums. • PPE procedure does not mandate circumstances when respiratory protection must be worn during mining operations in longwall and development areas. • Documented PPE procedures to reflect actual practice of workers

[22] Clause 119(2)(a), WHS (M&PS) Regulation

[23] Clause 50 WHS Regulation

	at the mine site. • Workers not provided with appropriate PPE for respirable dust hazard and no refresher training for PPE, including fit-testing. Training should be included in the mine's documented training system. • Work procedure documents do not reflect actual practice of longwall operator. • Inadequate access for mining supervisors to handheld air measurement devices in production areas.
Notices of concern, s 23	• Documents identify incorrect workplace exposure standard for respirable crystalline silica. • TARPs not developed for all foreseeable failures of controls for airborne dust. • Reasons for adopting or rejecting control measures not documented in the Principal hazard management plan (PHMP) as required by legislation. • Risk assessments did not include a reasonable mix of workers likely to be subject to the hazard being assessed, including operators and trades personnel. • PHMPs not audited against performance standards and not reviewed by triggering events identified in plans and legislation. • Safety management system documents did not state consistent information in relation to PPE requirements and operator positioning during mining operations, and triggers for replacing picks and sprays on longwall shearers and continuous miners. • Induction training does not include health consequences of exposure to airborne dust. • Frequency of air quantity measurements insufficient to detect rapid change in circumstances. • Insufficient resources allocated to implement proactive road works. • No documented standard for water sprays on conveyor belt installations.

The TAP process identified many common issues around the approach taken by the sites to manage the risk of worker exposure to respirable dust. It also highlighted broader issues that are common across mine sites associated with the process of developing, implementing and reviewing the risk assessments, management plans and procedures.

The regulator expects that all underground mines, not only underground coal operations, will review their procedures and practices in consideration of the findings of this report.

The requirement for principal hazard management plans to comply with legislative requirements, reduce risk to as low as reasonably practicable and give appropriate consideration to the implementation and management of critical controls apply at all types of mining operations.

Issued by

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Further information

For more information on targeted assessment programs, the findings outlined in this report, or other mine safety information, please contact the Resources Regulator's Mine Safety branch. You can find the relevant contact details below.

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Address	Resources Regulator, Mine Safety 516 High Street Maitland NSW 2320

Appendix A: Legislative requirements relating to worker exposure to respirable dust

The appendix provides a list of certain legislative requirements for the management of worker exposure to respirable dust referred to in this report as provided by the *Work Health and Safety (Mines and Petroleum Sites) Act 2013*, Work Health and Safety (Mines and Petroleum Sites) Regulation 2014, and Work Health and Safety Regulation 2017.

Legislation, section/clause	Legislative requirements
WHS Regulation, clause 36	Hierarchy of control measures
WHS Regulation, clause 44	Provision to workers and use of personal protective equipment
WHS Regulation, clause 49	Ensuring exposure standards for substances and mixtures not exceeded
WHS (M&PS) Regulation, clause 15	Performance standards and audit
WHS (M&PS) Regulation, clause 23 - 25	Principal hazard management plans
WHS (M&PS) Regulation, clause 38 - 42	Air quality and monitoring
WHS (M&PS) Regulation, clause 54 - 64	All underground mines—air quality and ventilation
WHS (M&PS) Regulation, clause 71	Ventilation
WHS (M&PS) Regulation, clause 76	Requirements if air quality or safety standards not met
WHS (M&PS) Regulation, clause 86	Sampling and analysis of airborne dust
WHS (M&PS) Regulation, Part 9	Licensed activities at coal mines
WHS (M&PS) Regulation, Schedule 6	Sampling airborne dust at coal mines

WHS (M&PS) Regulation, clause 119	Health monitoring reports kept as records
WHS (M&PS) Regulation, clause 121	Mine operator must consult with workers