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MINE SAFETY | TARGETED ASSESSMENT PROGRAM

Gas and ventilation management: NSW underground coal mines

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Executive summary

The targeted assessment program (TAP) commenced in March 2016 and provided a planned, intelligence-driven and proactive approach to assessing how effectively mine operators are managing the principal hazards defined in the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (the WHS (M&PS) Regulation).

This report summarises the findings of assessments undertaken in in relation to gas and ventilation management in underground coal mines. These assessments commenced in March 2016, and have been completed at nine mines.

The targeted assessment is an in-depth look at the control measures for methane gas and ventilation management and their implementation. The assessments are undertaken by a team of Mine Safety inspectors through a combination of desktop and physical assessments.

The mine operator of an underground coal mine must ensure the concentration of methane in the general body of air is as low as reasonably practicable and must not be greater than 2% by volume. Certain concentrations of methane in the general body of air can create an explosive atmosphere.

The findings of the assessments are grouped into those that are specific to the principal hazard of methane gas and ventilation management, and those that could be more generally applied to all aspects of critical control measure implementation.

General findings include the need to ensure that plans within the safety management system (SMS) are effectively managed and controlled, with appropriate review mechanisms developed and implemented. Risk assessments and supporting procedures should be incorporated into the management plans as necessary. In addition, audits and reviews of the plans should be undertaken to ensure that the plans and systems they support are appropriate, and the implementation of those systems should be addressed and followed.

The TAP-specific findings highlight the need to ensure that methane sensors and gas monitors are positioned to maximise the likelihood of detecting the gas being monitored and produce accurate readings. The mine operator must ensure that methane sensors and gas monitoring stations are located so that the system reflects the true analysis of the return airway free from possible dilution from intake ventilation leakage.

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. This approach also highlights the strong benefits of the multidisciplinary inspection team in identifying issues through one activity across relevant disciplines.

Background

In February 2016, NSW Mine Safety published the Mine safety regulatory reform: Incident prevention strategy (IPS). This strategy outlines significant changes proposed for the way that Mine Safety operates as a regulator, and supports and enforces compliance with the obligations of the NSW *Work Health and Safety (Mines and Petroleum Sites) Act 2013* (WHS (M&PS) Act), the NSW *Work Health and Safety Act 2011* (WHS Act) and associated regulations.

A key component of the strategy was the development and implementation of a risk-based intervention framework. This framework includes the identification and confirmation of risk profiles, incorporating risk control measure verification and the targeting of resources to areas of risk priority.

The practical implementation of the strategy has seen the development of two key targeted assessment activities. These are:

- **targeted assessment programs** (TAP): a planned and proactive program that assesses the overall effectiveness of an operator's attempt to control critical risk related to principal hazards
- **targeted interventions** (TI): an assessment initiated in response to a specific incident or intelligence that assesses how effectively relevant risks are being controlled (see below for further detail).

Targeted assessments

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. TAPs apply the following principles:

- a focus on managing prescribed 'principal hazards' from the WHS (M&PS) Regulation
- an 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 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 with legislation with respect to gas and ventilation management
    - controls the mine utilises to prevent and mitigate gas exceedances
    - ways the mine utilises to monitor the effectiveness of those controls
- workplace assessment of the implementation of those controls.

Process

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

- preparatory team meetings and document preparation
- information and assessment requirements discussed and supplied to the relevant mine
- 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 compliance of the relevant plans with legislative requirements
    - inspection of relevant site operations
- discussion and feedback to mine management team on the findings and ways forward.

Methane gas and ventilation management

In March 2016, Mine Safety began a series of targeted assessments relating to methane gas and ventilation management. This target area was determined through the analysis of incident notifications in 2015 and early 2016 relating to the exceedance of trigger levels for methane gas in underground coal mines.

Four mines were selected for the first round of TAPs, identified through their hazard burden profile. These profiles are based on a series of notifications of methane gas exceedance in 2015 and early 2016 required under clause 128(5) of the WHS (M&PS) Regulation. The findings and recommendations arising from the first round of TAPs was published in a consolidated report in September 2016, Gas and ventilation management – NSW underground coal mines. Five mines were selected for the second round of TAPs identified through their hazard burden profile based on the number of gas exceedance notifications together with data from the mines with regard to the mine's historical and projected gas content in mining domains.

It should be noted that operators of underground mines in NSW must now comply with the ventilation control plan requirements in clause 62 of the WHS (M&PS) Regulation. As part of the savings and transitional provisions, mine operators were permitted to rely on compliance with the provisions of the Coal Mine Health and Safety Regulation 2006 until 31 January 2017. This former Regulation required ventilation arrangements to be made, including plans and procedures, but without the formal requirement of a prescribed ventilation control plan.

Factors contributing to the registering of methane gas exceedances

While the particular contributing factors leading to methane gas exceedances are often specific to the mine, some common factors include:

- loss of main ventilation fans as a result of incoming power failure, for example, resulting from storm activity or electrical component faults
- unavailability of gas drainage plant as a result of high oxygen being detected in gas drainage lines, planned maintenance, or excessive water accumulation
- inadequate procedural control during a ventilation change, resulting in unplanned events
- failure of, damage to, or inappropriate adjustments to ventilation control devices
- floor breaks to lower seams in the longwall area.

Assessment findings

The assessment program revealed some issues associated with the implementation of critical controls intended to manage hazards associated with methane gas, and more generally with the process of developing, reviewing or implementing the controls. While the highlighted issues were not relevant at all of the sites assessed, the findings provide some valuable information for mine operators to consider when developing controls.

The findings are grouped into issues that are applicable generally to critical control management development, reporting and verification, and implementation, and those specific to this series of TAPs.

The **general** findings 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.

The **methane gas and ventilation management-specific findings** should be used to inform and improve safety management systems that are required to address this principal hazard.

Inspectors applied TAPs to enable an in-depth review of the principal hazard management related to methane gas and ventilation management systems. General comments from the process highlighted that:

- in conducting the TAPs, mine personnel were generally responsive in undertaking measures to address the issues raised
- notwithstanding some of the issues uncovered, mine personnel with specific responsibility for methane gas and ventilation management systems exhibited a satisfactory understanding of the operation, capacities and constraints of the mine's systems.

General findings

Areas of good practice

The assessment process revealed several areas of good practice.

- Some operations identified, as an outcome of risk assessments, a requirement to install additional sensors at locations other than those prescribed by legislation, in consideration of the likely sources of methane gas emissions.
- Maintenance plans and procedures for gas monitoring systems were comprehensive and complied with legislated requirements and applicable Australian Standards. The available evidence demonstrates that these plans and procedures were appropriately implemented.
- Operations were trialling, or actively investigating, the integration of remote methane monitoring with control systems on mining equipment; inhibiting cutting and/or tramming functions to improve the management of methane levels.

Document management

Issue	Response
Plans lacked detail about document management, including the owner of each document, review dates for referenced documents, records of compliance with review dates and audit dates.	The mine operator must develop procedures for the management of all the records needed to comply with the WHS Act and WHS Regulation. This is a mandatory element of the SMS. The procedures should address matters such as: • where records are kept so that they are available as required by legislation (e.g. for inspection) • the auditing and reviewing of records management as part of requirements for the SMS • where and how the mine record is to be maintained. Procedures for the management of records should ensure that access to SMS documentation is 'controlled'. This means: • only the most recent version is available and any supporting documentation, or data, is up to date • versions are identified and dated for periodic review • obsolete documents are removed and archived for reference and to satisfy legal requirements.

Risk assessments

Issue	Response
Risk assessments and supporting procedures for determining the location of methane sensors lacked detail in relation to the justification as to where sensors were, or were not, installed.	Mine operators must, for each principal hazard, carry out a risk assessment that involves a comprehensive and systematic investigation and analysis of all aspects of risks to health and safety associated with the hazard. This is a requirement under clause 23(2) of the WHS (M&PS) Regulation. A principal hazard manage plan must set out the reasons for adopting or rejecting control measures, which is a requirement under clause 24(3)(j) of the WHS (M&PS) Regulation. Mine operators must ensure that risk assessments are completed in a comprehensive and systematic manner. The determination of sensor positions must be undertaken in consideration of legislative requirements, and underpinned by a risk assessment.

Training

Issue	Response
Operators of diesel plant (for example, LHD operators) at mines did not know the shut-down level for methane gas or were unsure about whether the shut-down level was for carbon dioxide or methane.	Mine operators must ensure workers are given suitable and adequate information, training and instruction in regard to the nature of the work, the risks associated with the work and the control measures implemented. It must be provided in a way that workers can readily understand. (Refer to clause 39 of the NSW Work Health and Safety Regulation 2011).

Methane gas and ventilation management-specific findings

Ventilation control plan

Issue	Response
Ventilation control plans did not always consider the risks associated with rapid changes in barometric pressure and whether this affected the health and safety of workers.	Mine operators should consider the risks associated with barometric changes, including rapid changes. Operators should consider how these changes affect the health and safety of workers and what controls need to be put in place to ensure the health and safety of workers.
Intake air was found travelling across the face of a permanent seal at a mine. The mine could not provide evidence that an assessment of risks associated with intake air travelling across the face of a permanent seal had been completed.	Operators must, so far as is reasonably practicable, prevent intake air from travelling across the face of a permanent seal at the mine in accordance with clause 70(2)(a) of the WHS (M&PS) Regulation. The operator must consider the risks associated with intake air travelling across the face of a permanent seal at a mine and include arrangements in the ventilation control plan for managing risks to health and safety. This is a requirement under clause 62(3)(d) of the WHS (M&PS) Regulation.
Trigger action response plans (TARPs) prepared by mine operators had trigger levels for methane set too high. Trigger levels should prevent exceedances or methane concentrations reaching dangerous levels.	Procedures and TARPs should be structured so mitigation responses are triggered in a timely manner. This reduces the likelihood of elevated levels of methane occurring in the work environment.
Procedures and TARPs prepared by mine operators permitted workers to remain underground with dangerous levels of methane present in accessible parts of the mine.	Mine operators should ensure procedures are in place to identify and respond to increasing methane trends so that, in the event of a withdrawal of workers from the mine, workers are not exposed to potentially dangerous levels of methane prior to reaching the surface of the mine.

Methane sensor and gas monitor locations

Issue	Response
Mine operators did not ensure that methane sensor heads were positioned to maximise the likelihood of the detection of methane gas and to produce accurate readings, in accordance with clause 72(3)(a) of the WHS (M&PS) Regulation.	Mine operators must ensure that methane sensors and gas monitoring stations are located so that the system reflects the true analysis of the return airway free from possible dilution from intake ventilation leakage e.g. from vehicle airlock doors and conveyor belt seals.
Mine operators did not ensure that gas monitoring stations were positioned to maximise the likelihood of detecting the gas being monitored and produce accurate readings in accordance with clause 73(1)(i) WHS (M & PS) Regulation.	As above.

Emergency sealing of mine

Issue	Response
Facilities not available for the rapid sealing of all, or part of, the mine.	Mine operators of underground coal mines must have procedures for emergency sealing of the mine from a safe place (including from a place out of the direct line of any potential blast) in accordance with clause 5 of Schedule 7 of the WHS (M&PS) Regulation. The ventilation control plan must include a description of the arrangements for sealing all, or part of the mine. (Clause 62(3)(h) of the WHS (M&PS) Regulation.)

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 the issuing of notices, including notices of concern, under section 23 of the WHS (M&PS) Act, and improvement notices, under section 191 of the WHS Act 2011.

The matters addressed by the notices reflect the findings of the Mine Safety inspectors. In summary, these findings are:

Notice	In relation to
Improvement notices, s 191	• location of methane sensors and gas monitors near intake air leakages • risk assessment required to inform placement of methane sensors and gas monitors • intake air travelling across the face of a permanent seal
Notices of concern, s 23	• location of methane sensors and gas monitors • development and implementation of processes for document control and review • facilities for emergency sealing of mine

The TAP process identified issues common to many sites around the approaches taken to methane gas and ventilation management. It also highlighted broader issues associated with the process of developing, implementing and reviewing the risk assessments, management plans and procedures applicable across the mine sites.

The Regulator expects that all mines will review their procedures and practices in light of the findings of this summary. Many of the general issues identified in this report are not restricted to underground coal mines.

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 how operators consider 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 or targeted interventions, 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.

Contact type	Contact details
Address	Resources Regulator, Mine Safety 516 High Street Maitland NSW 2320
Phone	02 4931 6666
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Incident reporting	To report an incident or injury call **1300 814 609**
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Appendix A: Legislative requirements relating to gas and ventilation management

The appendix provides a list of certain legislative requirements for gas and ventilation management 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 2011.

Legislation, section/clause	Legislative requirements
WHS (M&PS) Regulation, clause 62	Ventilation control plan (1) The mine operator of an underground mine must ensure that a ventilation control plan is prepared to provide for the management of all aspects of ventilation at the mine. (2) The ventilation control plan must describe all control measures implemented in relation to ventilation at the mine. (3) …. the ventilation control plan must include a description of…. (h) in the case of an underground coal mine – arrangements for sealing all, or part of, the mine…
WHS (M&PS) Regulation, clause 70(2)(a)	Goaf areas and abandoned or sealed workings (2) The mine operator must: (a) so far as is reasonably practicable, prevent intake air from travelling across the face of a permanent seal at the mine…
WHS (M&PS) Regulation, clause 71(4)	Ventilation (4) The mine operator of an underground coal mine must ensure that the effectiveness of the ventilation system and the ventilation control plan for the mine are audited at least once every 12 months by an individual nominated to exercise the statutory function of ventilation auditor at the mine.
WHS (M&PS) Regulation, clause 73(1)(i)	Gas monitoring (1) The mine operator of an underground coal mine must ensure that: (a) the gas content of the air at the mine is monitored, and…. (i) detection heads of gas content monitoring plant are positioned to maximise the likelihood of detecting the gas being monitored and producing accurate readings.

WHS (M&PS) Regulation, clause 128(5)	Duty to notify regulator of certain incidents (b) the detection of a concentration of methane in the general body of the air at an underground coal mine (other than in a sealed area or goaf) that is greater than 2% by volume …
WHS Regulation, clause 38	Review of control measures (1) A duty holder must review and as necessary revise control measures implemented under this Regulation so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health or safety. (2) Without limiting subclause (1), the duty holder must review and as necessary revise a control measure in the following circumstances: (a) the control measure does not control the risk it was implemented to control so far as is reasonably practicable …
WHS Regulation, clause 39	Provision of information, training and instruction (1) This clause applies for the purposes of section 19 of the Act to a person conducting a business or undertaking. (2) The person must ensure that information, training and instruction provided to a worker is suitable and adequate having regard to: (a) the nature of the work carried out by the worker, and (b) the nature of the risks associated with the work at the time the information, training or instruction is provided, and (c) the control measures implemented. (3) The person must ensure, so far as is reasonably practicable, that the information, training and instruction provided under this clause is provided in a way that is readily understandable by any person to whom it is provided.