NSW Resources Regulator

TARGETED ASSESSMENT PROGRAM

Interim consolidated report - Managing fire or explosion risks in underground coal mines

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Contents

Executive summary

This interim report summarises the findings of assessments undertaken at eight underground coal mines in relation to the management of fire or explosion risks.

The findings of the assessments can be grouped into those that could be generally applied to all aspects of the risk management process at the mine and those that are specific to the hazard of fire or explosion.

Whilst all mines demonstrated a risk-based approach to the management of the fire and explosion hazards, risk assessments did not always provide absolute clarity on the actual preventative and mitigating control measures to manage the risk. Risk assessments should clearly identify all hazards applicable to the site and nominate specific risk controls rather than citing management plans and procedures as control measures.

Several mines are implementing critical control identification and management processes. It was identified that mines did not always have a clearly documented plan guiding implementation and integration of critical control concepts into the existing safety management system. It is recommended mines have clearly documented implementation plans for the introduction of critical controls and ensure the criteria for critical control selection is clearly defined.

The assessment teams identified that mines continue to maintain an approach to the provision of firefighting equipment based on previous prescriptive legislation, mining design guidelines (MDGs) and Australian Standards. Failing to challenge this approach through a risk-based process has in some circumstances led to the provision of inappropriate firefighting equipment and failure to recognise the hazard exposure to first responders. It is essential that mines adopt a risk-based approach to the provision of firefighting equipment considering fuel volatility, fuel load, safety of first responders as well as considering published guidance material.

It was also identified that mine procedures for responding to carbon monoxide alarms, an early indicator of a fire event, focus on validating the alarm before initiating procedures for the withdrawal of workers. It is recommended that mines ensure that procedures for the response to carbon monoxide alarms provide for the timely withdrawal of persons from the mine to facilitate the best possible opportunities for self-escape.

Introduction

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 WHS (MPS) 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 mining, electrical and mechanical engineering who work together with the operation's management team to undertake an assessment of the risk control measures associated with the relevant hazard and their implementation.

Scope

The scope of the targeted assessments includes two elements:

- a desktop assessment of:
  - compliance against legislation with respect to the management of risks to health and safety associated with fire or explosion at the mine
  - controls the mine utilises to prevent and mitigate the risks to health and safety associated with fire or explosion
  - 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:

- preliminary team meetings, preparation and review of documents
- execution of an on-site assessment involving:
  - a site desktop assessment of relevant plans and processes measuring legislative compliance of the relevant plans
  - the inspection of relevant site operations.
- discussion and feedback to the mine management team on the findings and actions that need to be taken by the operators in response.

Managing fire or explosion risks in underground coal mines

Managing the risk of fires and explosions is particularly important at underground coal operations due to the hazardous nature of the environment. Fires and explosions are identified in the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (WHS (MPS) Regulation) as a principal hazard that has a reasonable potential to result in multiple deaths in a single incident or a series of recurring incidents (clause 5(a)).

The WHS (MPS) Regulation requires mine operations to identify principal hazards and conduct a risk assessment that involves a comprehensive and systematic investigation and analysis of all aspects of risk to health and safety associated with the principal hazard (clause 23) and prepare a principal hazard management plan for each principal hazard (clause 24).

Additionally, the Work Health and Safety Regulation 2017 prescribes the requirement to manage the hazards associated with flammable gas, vapour, mist or fumes and combustible dust (clause 51).

In developing the control measures to manage the risks of fire or explosion, Schedule 1, clause 6 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 requires that the following matters must be considered:

- → the potential sources of flammable, combustible and explosive substances and materials, both natural and introduced, including gas, dust, ores, fuels, solvents and timber
- → the potential sources of ignition, fire or explosion, including plant, electricity, static electricity, spontaneous combustion, lightning, light metal alloys, hot work and other work practices
- → the potential for propagation of fire or explosion to other parts of the mine
- → the potential sources of flammable material with a flash point of less than 61° Celsius, including materials on the top of any shaft, outlet or well at the mine
- → arrangements for the management and control of the transport and storage of combustible liquids
- → arrangements for the prevention of fires, including the types and location of systems for the early detection and suppression of fires
- → the equipment for fighting fire at the mine
- → the arrangements for the management and control of volatile or hazardous materials in underground mines
- → procedures to be used for carrying out hot work at the mine.

Additional information and guidance on managing risks associated with fire or explosion may be available from the published guidance stated at Appendix A.

Assessment findings

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

Risk Assessment

Issue: While all mines demonstrated a risk-based approach to the management of fire and explosion hazards, risk assessments did not always provide clarity on the hazard being assessed and the actual preventative and mitigating control measures that have been identified to manage the risk.

Response: Risk assessments should clearly identify all hazards applicable to the site and risk controls nominated should be clearly defined rather than citing management plans and procedures as control measures. For example; a site hazard may be a bath house building fire with preventative and mitigating controls potentially including minimising the storage of flammable cleaning products, automatic fire detection systems, automatic sprinkler systems, strategic placement of fire extinguishers, fire hydrants and fire depots equipped with equipment appropriate for a building fire.

The identification and implementation of specific risk controls facilitates compliance with legislation that requires mine operators to keep a record of control measures implemented to eliminate or minimise identified risks[1], and demonstrates the use of the hierarchy of controls.[2]

Critical controls

Issue: Mines are implementing a critical control identification and management process. It was identified that some mines did not have a clearly documented plan for implementation and integration into the existing safety management system and did not have clearly defined criteria for critical control selection.

Response: The International Council on Mining & Metals (ICMM) provides guidance on the implementation of critical control management systems. This guidance advises that "a successful CCM process will have monitoring and reporting components embedded into business-as-usual

[1] Clause 9 WHS (MPS) Regulation

[2] Clause 36 WHS Regulation

operations, this includes integrating scheduled verification activities and reporting into current maintenance and inspection systems".[3]

Additionally, there should be a fundamental understanding of the critical control approach at all levels of the organisation and an iterative process of review.

In relation to selection of critical controls, mines should ensure that criteria are clearly defined to ensure a credible and sustainable focus on those controls having greatest impact in managing risks associated with rare but catastrophic unwanted events. The ICMM provides a definition for critical control that may provide guidance in the selection of site critical controls.[4]

Specific findings

Response to carbon monoxide (CO) alarms

Issue: It was identified that mine procedures for responding to carbon monoxide (CO) alarms, an early indicator of a fire event, focus on validating the alarm before initiating procedures for the withdrawal of workers.

Response: Mines must ensure that procedures for the response to carbon monoxide alarms provide for the timely withdrawal of persons from the mine to facilitate the best possible opportunities for self-escape.

Fire prevention, detection and suppression

Issue: Mines continue to maintain an approach to the provision of firefighting equipment based on previous prescriptive legislation, mining design guidelines (MDGs) and Australian Standards. Failing to challenge this approach through a risk-based process has in some circumstances led to the provision of inappropriate firefighting equipment and failure to recognise the hazard exposure to first responders.

Response: When developing control measures mine operators must consider the equipment and arrangements for the prevention, suppression and fighting of fires, and must ensure the provision of adequate fire-fighting equipment.[5] Mines should adopt a risk-based approach to the provision of firefighting equipment considering fuel volatility, fuel load, safety of first responders and the published guidance material.

[3] Critical Control Management Implementation Guide, International Council on Mining & Metals, 2015, p50

[4] Critical Control Management Implementation Guide, International Council on Mining & Metals, 2015, p53

[5] Schedule 1(6) WHS (MPS) Regulation, Clause 359 WHS Regulation

Issue: Most mines have identified real time temperature and in some cases vibration monitoring for rotating components of critical plant (pulleys, gearboxes, motors, etc) as a preventative control for equipment fires. However, the method for determination of which components, and how the components are to be monitored, could not be verified.

Response: When developing control measures mine operators must consider the potential sources of ignition, fire or explosion, including plant.[6] When systems are identified as risk controls, consideration should be given to the specification of the system to ensure the expected risk control effectiveness is achieved. These considerations should include accuracy, reliability, alarm and trip levels and operator response to alarm trip and failure modes.

Hot work areas

Issue: Mines controlled risks associated with hot work using designated hot work areas located in or near workshops, and for all other areas permit systems were in place. At some sites inspections and interviews identified that there was some confusion as to the extent of designated hot work areas and the minimum standards required to be maintained within those areas.

Response: When developing the control measures to manage the risks of fire or explosion mine operators must consider hot work.[7] Mine operators should ensure that the minimum requirements, including firefighting equipment and housekeeping standards for designated hot work areas, and the actual site locations, are documented within the safety management system. Designated hot work areas should be clearly sign posted and demarcated and housekeeping standards maintained i.e. removal of rags, packaging, oil spills, aerosol cans and safe access and egress.

Conveyor belt inspections

Issue: All mines nominated conveyor belt inspections as a risk control for fires; however, most relied upon the review of inspection reports to monitor the effectiveness of this control.

Response: In complying with clause 9, mine operators must manage risks to health and safety associated with the operation of belt conveyors at the mine.[8] Mines should implement rigorous processes to verify the effectiveness of all risk controls, including conveyor inspections. For example, mines should consider independent inspections of conveyor systems to provide assurance that the expectations for the minimum standard of routine inspections are being met.

[6] Schedule 1(6) WHS (MPS) Regulation

[7] Schedule 1(6) WHS (MPS) Regulation

[8] Section 44A WHS (MPS) Regulation

Potential for propagation

Issue: Some mines could not demonstrate appropriate consideration in safety management system documentation of the potential for the propagation of fire or explosion throughout the mine, including arrangements for rapid sealing and segregation of roadways.

Response: When developing control measures to manage the risks of fire or explosion, mine operators must consider the potential for propagation of fire or explosion to other parts of the mine[9] and must ensure that procedures are in place for emergency sealing of all or part of the mine from a safe place (including from a place out of the direct line of any potential blast).[10]

The provision of pre-installed rapid sealing arrangements at mine entries and in strategic positions underground can assist in the mitigation of a fire event. Remotely operated sealing devices also provide an additional level of safety for emergency response crews.

Post incident monitoring of mine atmosphere

Issue: Most mines could not demonstrate proper consideration in safety management system documentation of arrangements for post incident monitoring of the atmosphere of the mine following a fire or explosion that leads to withdrawal of persons from the mine.

Response: Mine operators must ensure that arrangements are developed and implemented for the monitoring, so far as is reasonably practicable, of the atmosphere of the mine following an explosion or fire that leads to the withdrawal of persons from, and the cutting of the supply of power to, all or part of the mine.[11]

Strategically placed real time monitoring with uninterruptable power supplies and tube bundle monitoring points can provide valuable information on the nature of the mine atmosphere post a fire or explosion event. This information can assist incident management teams to make decisions on the risks associated with re-entry or recovery of the mine. Mines should not assume that all monitoring will be damaged and destroyed in a fire or explosion event.

Areas of good practice

→ Most mines have introduced the use of carbon monoxide sensors around conveyor drive heads to facilitate the early detection of fires. To verify the sensors are positioned to

[9] Schedule 1(6) WHS (MPS) Regulation

[10] Clause 88 and Schedule 7(5) WHS (MPS) Regulation

[11] Clause 77 WHS (MPS) Regulation

maximise the likelihood of detection some mines have utilised smoke tubes to confirm the flow of air across the sensor.

→ During the targeted assessments inspectors observed that some mines had clearly displayed signage reinforcing to the workforce the required housekeeping standards for the designated hot work area. The signage below was observed during a targeted assessment displayed at a surface hot work area.

→ Some mines have started to implement a critical control management strategy to manage risks associated with fire or explosion. This approach provides focus on those controls critical to preventing the rare but catastrophic fire or explosion events. The International Council on Mining & Metals (ICMM) advises that when clearly defined and understood, critical controls are an effective means to prevent fatal and catastrophic hazards and advocates a nine-step process that effectively focuses risk management on controls most critical for health and safety.[12] Guidance in relation to identifying and implementing critical controls is available at International Council on Mining & Metals (ICMM), Critical Control Management.

[12] Health and Safety Critical Control Management Good Practice Guide, International Council on Mining & Metals, 2015

Compliance

Notices were issued by assessment teams in response to the following identified compliance issues.

Notice	In relation to
Prohibition notice, s 195 Section 195, *Work Health and Safety Act 2011*	→ Conveyor system issues including build-up of coal fines, seized and defective rollers and belt tracking issues with inoperable tracking aids causing friction and belt fibres.
Improvement notices, s 191 Section 191, *Work Health and Safety Act 2011*	→ Failure to identify hazards associated with the early detection of fire or explosive mixtures of gas and inadequate provision of suitable firefighting equipment at the underground bin. → Failure to ensure ventilation quantity is measured on a regular basis by mining supervisors to ensure compliance with ventilation requirements stated in clause 71 WHS(MPS) Regulation. → Exposed diesel fuel in open bund in underground storage. → Underground storage of oil drums in a location not protected from hazards including vehicle impact. → Underground storage of oil drums not bunded. → Inadequate fire-fighting equipment located near underground fuel pod. → Inappropriate stowage / discarding of flammable material underground. → Failure of Mechanical Engineering Control Plan to address legislated requirements in relation to fire resistant hydraulic fluids and failure to reference Hot Work Management Plan.
Notices of concern, s 23 Section 23, *Work Health and Safety (Mines and Petroleum Sites) Act 2013*	→ Combustible material located near surface diesel fuel tank and surface bulk oil storage. → Concern of possible inadequate bunding capacity. → Condition of belt wander switches and pull wire lanyard on conveyor belt.

Where to now

The targeted assessment program for fire or explosion is ongoing for underground coal operations.

The publishing of this interim report provides all operators with an opportunity to review their own safety management systems armed with the insight and knowledge gained by the assessment team with respect to the management of fire and explosion risks.

The outcomes of these targeted assessments will provide information that will be used to inform the regulator's ongoing education and compliance efforts.

This targeted assessment program has identified many common issues around the approach taken by sites to manage the hazard of fire or explosion. It also highlighted broader issues that are common across mine sites associated with the process of developing, implementing and reviewing risk assessments, management plans and procedures.

Operations should be challenging their control measures which are solely based on guidelines, standards and previous prescriptive legislation and ensure risks are being managed so far as reasonably practicable. Mine operators should also ensure they have robust systems in place to verify the effectiveness of their risk control measures.

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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Appendix A: Legislative requirements and published guidance relating to the management of fire or explosion risks

The following is a list of certain legislative requirements for the management of fire or explosion 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.

Legislation, section/clause	Legislative requirements
WHS (MPS) Regulation, clause 9	Management of risks to health and safety
WHS (MPS) Regulation, clause 44A	Operation of belt conveyors
WHS (MPS) Regulation, clause 77	Post incident monitoring
WHS (MPS) Regulation, clause 88	Duty to prepare emergency plan
WHS (MPS) Regulation, Schedule 1, clause 6	Schedule 1 Principal hazard management plans—additional matters to be considered
WHS (MPS) Regulation Schedule 7, clause 5	Schedule 7 Matters to be included in emergency plan
WHS Regulation, clause 36	Hierarchy of control measures
WHS Regulation, clause 359	Fire protection and firefighting equipment

The following published guidance material may assist mine operators to manage risks associated with fire or explosion;

Code of Practice: Managing risks of hazardous chemicals in the workplace (Safe Work Australia)

MDG 1032 - Guideline for the prevention, early detection and suppression of fires in coal mines (NSW Resources Regulator)

Safety Bulletin 17-02: Mines and preparing for fires (NSW Resources Regulator)

Safety Bulletin 13-05: Too many underground fires (NSW Resources Regulator)

Safety Alert: Workers withdrawn after methane frictional ignition (March 2018) (NSW Resources Regulator)

Fire and Rescue NSW - Guidelines and general information (Fire and Rescue NSW)

Fire or explosion in underground mines and tunnels (Worksafe New Zealand)

Critical control management (International Council on Mining and Metals (ICMM))