

NSW
Resources
Regulator

TARGETED ASSESSMENT PROGRAM

**Interim consolidated report –
Managing fire or explosion risks in
underground metalliferous mines**

February 2019



Document control

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

Title: Targeted assessment program - Interim consolidated report – Managing fire or explosion risks in underground metalliferous mines

First published: February 2019

Authorised by: Chief Inspector of Mines

CM9 reference: DOC18/960947

Amendment schedule

Date	Version	Amendment
11 February 2019	1	First published

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Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (February 2019). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the NSW Department of Planning and Environment or the user's independent advisor.

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Executive summary

This report summarises the findings of targeted assessments undertaken at six underground metalliferous mines in relation to the management of fire or explosion risks.

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

General findings included a lack of integration of safety management system documentation from risk assessment through to fire or explosion principal hazard management plan, principal control plans and other documents. In some cases, fire or explosion principal hazard management plans were not underpinned by risk assessment and failed to consider all legislated requirements.

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. Mines should have clearly documented implementation plans for the introduction of critical controls and ensure the criteria for critical control selection is clearly defined.

Specific findings included that some mines failed to identify all reasonably foreseeable hazards and risk controls in risks assessments associated with fire or explosion for fixed plant and mobile equipment introduced to site. When identifying control measures to manage the risks of fire or explosion at the mine operators must consider the potential sources of ignition; including, fixed and mobile plant, the arrangements for the prevention of fires including the types and location of systems for the early detection and suppression of fires, and the equipment for fighting fire at the mine.

All mines assessed with air compressors located underground failed to identify the hazards associated with compressor failure which may lead to fire and the risk of reticulating contaminated air into refuge chambers from underground fire events elsewhere in the mine. The mines were unable to demonstrate consideration of the hierarchy of controls to eliminate this hazard by locating air compressors on the surface.

At all mines assessed underground explosives magazines did not comply with Australian Standard, AS 2187 *Explosives – Storage, transport and use*, as is required by clause 31(2) of Work Health and Safety (Mines and Petroleum Sites) Regulation 2014. The various non-compliances with the Australian Standard related to the design, construction and management of the magazines. To ensure compliance mine operators should undertake an audit of their underground explosives magazines against the requirements of the Australian Standard.

Background

The targeted assessment program (TAP) provides a planned, risk-based 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 (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 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 an assessment of the 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 metalliferous mines

Fires and explosions are identified in the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (WHS (M&PS) 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 (M&PS) 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 WHS (M&PS) Regulation 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 the following 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.
- **Areas of good practice** observed during targeted assessments that may provide guidance for all mines.

General findings

Document management

Issue: Some mines could not demonstrate integration of safety management system (SMS) documentation from risk assessment through to fire or explosion principal hazard management plan, explosives principal control plan and other SMS documents. It was observed that some fire or explosion principal hazard management plans and explosives principal control plans did not reference all subordinate documents for managing risks to health and safety, including procedure documents.

Response: Mine operators must ensure that the SMS provides a comprehensive and integrated system for the management of all aspects of risks to health and safety at the mine.¹

Mine operators should ensure that when principal hazard management plans and principal control plans refer to additional documents to meet legislated requirements identified at clause 24 and clause 26 of WHS (M&PS) Regulation, the referenced documents are clearly identifiable and current to ensure accessibility and relevance for any person required to access the documents.

Issue: Some mines did not have clearly documented triggers for review of SMS documents when changes to work procedures or systems of work occurred.

It was also observed that some SMS documents had not been reviewed in accordance with stated review schedules and therefore failed to demonstrate currency and effectiveness.

Response: Mine operators must ensure that the SMS for the mine is reviewed within 12 months of the commencement of mining operations and at least once every three years after that to ensure it remains effective. In addition, if a control measure is revised under clause 38 of the WHS Regulations or clause 10 of WHS (M&PS) Regulation, the operator must ensure that the SMS is reviewed and as necessary revised in relation to all aspects of risk control addressed by the revised control measure.²

¹ Clause 13 WHS (M&PS) Regulation

² Clause 17 WHS (M&PS) Regulation

Risk assessment

Issue: It was observed at some mines that risk assessments underpinning the fire or explosion principal hazard management plan failed to consider all surface and underground work areas and work activities undertaken at the mine and therefore failed to identify all reasonably foreseeable hazards.

Response: Mine operators have a duty to identify reasonably foreseeable hazards³, and must identify all principal hazards associated with mining operations at the mine site, and must conduct, in relation to all principal hazards identified, a risk assessment.⁴ Additionally, mine operators have a general duty to manage risks associated with mining operations through undertaking risk assessment in accordance with clause 9, WHS (M&PS) Regulation.

Risk assessments should consider all areas of the mine and tasks undertaken to identify all hazards applicable to the site and should demonstrate management of risk through nominating clearly defined risk controls.

Issue: Some mines could not demonstrate that the fire or explosion principal hazard management plan considered mandatory matters identified at Schedule 1, clause 6 of WHS (M&PS) Regulation and could not clearly demonstrate how identified risks associated with those matters were being managed.

Response: When developing control measures to manage risks associated with fire or explosion the principal hazard management plan must include consideration of matters specified at Schedule 1, clause 6 WHS (M&PS) Regulation, and must provide for the management of all aspects of risk control in relation to the principal hazard.⁵

Critical controls

Issue: All mines assessed 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 (CCM) systems. This guidance advises that, “a successful CCM process will have monitoring and reporting components embedded into business-as-usual operations, this includes integrating scheduled verification activities and reporting into current maintenance and inspection systems”.⁶

³ Clause 34 WHS Regulation

⁴ Clause 23 WHS (M&PS) Regulation

⁵ Clause 24 WHS (M&PS) Regulation

⁶ Critical Control Management Implementation Guide, International Council on Mining & Metals, 2015, p50

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.⁷

Training

Issue: While all mine operators demonstrated theory-based worker training in the use of fire extinguishers and fire suppression systems, some worker interviews identified inadequate practical training in the operation of this equipment.

Response: Mine operators must ensure that each worker at the mine is provided with suitable and adequate information, training and instruction having regard to the hazards associated with the work carried out by the worker, the implementation of control measures, relevant parts of the safety management system and the emergency plan for the mine.⁸

Issue: It was identified that some mine operations had not conducted comprehensive testing of the mine emergency plan within the previous 12-month period as required by clause 93 WHS (M&PS) Regulation.

Response: Mine operators must test the emergency plan for the mine at intervals of no more than 12 months and as soon as is reasonably practicable after there has been a significant revision to the plan.⁹

When testing the mine emergency plan, it is recommended that mine operators undertake a scenario-based exercise of a foreseeable emergency event that ensures a rigorous and comprehensive examination of all aspects of the emergency plan, for example, a plant tyre fire in the mine decline.

⁷ Critical Control Management Implementation Guide, International Council on Mining & Metals, 2015, p53

⁸ Clause 39 WHS Regulation, clause 104 WHS (M&PS) Regulation

⁹ Clause 93 WHS (M&PS) Regulation

Specific findings

Placement of air compressors underground

Issue: Mines with air compressors located underground were unable to demonstrate adequate consideration of risks of fire to the plant and risks associated with reticulation of compromised air into refuge chambers in the event of an underground fire elsewhere in the mine.

Response: Mine operators must manage risks to health and safety associated with mining operations at the mine site in accordance with Part 3.1 of the WHS Regulations,¹⁰ including consideration of the hierarchy of controls¹¹ to eliminate the hazard by locating air compressors at the surface.

Issue: It was observed that all air compressors located underground were not fitted with fire suppression or capacity for remote shut-down in an emergency and mine operators were generally unaware of OEM fitted alarms and automatic shut-down features.

Response: When developing control measures to manage the risks of fire or explosion mine operators must consider the potential sources of ignition including plant, the arrangements for the prevention of fires including the types and location of systems for the early detection and suppression of fires and the equipment for fighting fire at the mine.¹²

Issue: It was observed that some underground air compressors were not located to ensure that ventilated air passing over the compressor is routed to a return airway as near as practicable to the compressor.

Response: Mine operators should consider Annex I (General requirements when locating compressors underground), clause 10 of mining design guideline, *MDG18 Air compressors – underground use*, which states that ventilating air passing over air compressors should be routed to the return airway as near as is practicable after passing the compressor.

Explosives control plan and underground explosives magazines

Issue: Some mines could not demonstrate that the explosives control plan had been reviewed and updated as required by legislation and therefore failed to demonstrate currency and effectiveness of the plan.

¹⁰ Clause 9, WHS (M&PS) Regulation

¹¹ Clause 36 WHS Regulation

¹² Schedule 1, clause 6, WHS (M&PS) Regulation

Response: Mine operators must ensure that the safety management system is reviewed within 12 months of the commencement of mining operations and at least once every three years after that. In addition, if a control measure is revised under clause 38 of the WHS Regulations or clause 10 of WHS (M&PS) Regulation, the operator must ensure that the safety management system is reviewed and as necessary revised in relation to all aspects of risk control addressed by the revised control measure.¹³

Issue: Some mine operators produced explosives control plans that included generic design guidelines that did not demonstrate a site risk-based approach to the management of explosives. The control plans lacked adequate detail in relation to the location of explosives magazines, the type and quantity of explosives stored in each magazine, the testing of magazine fire suppression systems and explosives stocktaking procedures.

Response: Operators of a mine site at which there is a risk to health and safety associated with explosives or explosive precursors must prepare an explosives control plan for the mine that sets out how the operator will manage those risks in accordance with clause 9 of WHS (M&PS) Regulation.¹⁴

Issue: It was observed that underground explosives magazines did not comply with requirements of AS 2187 *Explosives – Storage, transport and use*, in relation to design, construction and management.

Response: Mine operators should consider clause 31(2), WHS (M&PS) Regulation, which requires mines to store and handle explosives in compliance with AS2187. To achieve compliance mine operators should undertake a full audit of underground explosives magazines against the requirements of the Australian Standard and are encouraged to consider the diagram in Appendix G, which provides guidance in relation to the design of underground explosives magazines.

Risk controls for mobile and fixed plant

Issue: It was observed at some mines that fire suppression systems and other risk control measures on fixed and mobile plant, including heat shields and lagging, were not always implemented to maximise effectiveness and were not always fit-for-purpose for the equipment.

Response: When developing risk control measures to manage the risks of fire or explosion mine operators must consider the potential sources of ignition on fixed and mobile plant and the arrangements for the prevention, detection and suppression of fires.¹⁵

Mine operators should adopt a risk-based approach to ensure that fire extinguishers provided to fight fire on fixed and mobile plant are located to facilitate safe access to maximise effective response and

¹³ Clause 17 WHS (M&PS) Regulation

¹⁴ Clause 26, WHS (M&PS) Regulation

¹⁵ Schedule 1, clause 6, WHS (M&PS) Regulation

that all risk control measures including heat shields and lagging are fit-for-purpose and managed to remain effective throughout the lifecycle of the plant.

Mining design guideline (*MDG15 -Mobile and transportable plant for use on mines and petroleum sites*, clause 4.6.1 Fire risk assessment) provides guidance in relation to considerations for risk assessment of fire risks associated with the mobile plant.

Issue: It was observed at some mines that risk assessments to manage fire or explosion risks in relation to diesel equipment generally considered diesel equipment collectively, failing to consider the specific types of diesel equipment at the mine site.

Response: When developing control measures to manage the risks of fire or explosion mine operators must consider the potential sources of ignition associated with all diesel plant at site having regard to individual characteristics, hazards and risks associated with specific plant.

Bushfire

Issue: Some mines did not identify a reasonably foreseeable hazard of bushfire in site risk assessments and therefore did not manage risks associated with bush fire as part of the mine safety management system (SMS).

Response: Mine operators must identify reasonably foreseeable hazards that could give rise to risks to health and safety at the mine site,¹⁶ and where identified, must manage the risks in accordance with clause 9, WHS (M&PS) Regulation.

As part of managing risks associated with bushfire at the mine site mine operators must ensure that the mine emergency plan includes any site procedures implemented for managing bushfire risks at the mine as well as details of the persons having the competency to fight fires and to train others in fire-fighting.¹⁷

Areas of good practice

It was identified that one mine had implemented a risk control intended to prevent smoke dispersing throughout the underground atmosphere in the event of fire at an underground fuel storage area. The risk control includes a fusible pilot line that holds a ventilation control device in place with the intention that a fire event will cause the fusible pilot line to burn, releasing the regulation device and opening a ventilation pathway directly to the return airway.

¹⁶ Clause 34, WHS Regulation 2017

¹⁷ Schedule 7, clause 5 WHS (M&PS) Regulation

Compliance

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

Notice	In relation to
Improvement notices, s191 Section 191, <i>Work Health and Safety Act 2011</i>	<ul style="list-style-type: none"> → Unlabelled opened bulk container in work area containing unknown chemical. → Failure to consider reasonably foreseeable hazard of bushfire. → Emergency plan identifying disused escapeways as accessible. → Underground explosives magazines non-complaint with AS 2187, as is required by clause 31, WHS (M&PS) Regulation. → Inoperable fire alarms for electrical switchrooms that were identified as a risk control in risk assessment.
Notices of concern, s23 Section 23, <i>Work Health and Safety (Mines and Petroleum Sites) Act 2013</i>	<ul style="list-style-type: none"> → No signs for restricted access to a toxic or corrosive work area. → Concerns regarding placement of fire extinguishers. → Workers not provided with practical training in the use of fire extinguishers → Concerns regarding inadequate frequency of scenario emergency exercises. → Inadequate bunding of lubricants and chemicals. → Positioning of heat shield blankets fitted to fuel tanks on mobile plant.

Where to now

The targeted assessment program for fire or explosion is ongoing for underground metalliferous mines.

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 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

Garvin Burns
Executive Director Mine Safety Inspectorate – Chief Inspector of Mines
NSW Resources Regulator
NSW Department of Planning and Environment

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.

Type	Contact details
Email	cau@planning.nsw.gov.au
Incident reporting	To report an incident or injury call 1300 814 609
Website	resourcesregulator.nsw.gov.au
Address	Resources Regulator 516 High Street Maitland NSW 2320

Appendix A: Legislative requirements and published guidance material 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 (M&PS) Regulation, clause 9	Management of risks to health and safety
WHS (M&PS) Regulation, Clause 13	Duty to establish and implement safety management system
WHS (M&PS) Regulation, clause 17	Review
WHS (M&PS) Regulation, clause 23	Identification of principal hazards and conduct of risk assessments
WHS (M&PS) Regulation, clause 24	Preparation of principal hazard management plan
WHS (M&PS) Regulation, clause 26	Principal control plans
WHS (M&PS) Regulation, clause 31	Explosives and explosive precursors
WHS (M&PS) Regulation, clause 93	Testing of emergency plan
WHS (M&PS) Regulation, clause 104	Duty to provide information, training and instruction
WHS (M&PS) Regulation, Schedule 1, clause 6	Schedule 1 Principal hazard management plans—additional matters to be considered

WHS (M&PS) Regulation
Schedule 7, clause 5

[Schedule 7 Matters to be included in emergency plan](#)

WHS Regulation,
clause 34

[Duty to identify hazards](#)

WHS Regulation,
clause 36

[Hierarchy of control measures](#)

WHS Regulation,
clause 39

[Provision of information, training and instruction](#)

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

[MDG18 Air compressors \(underground use\)](#) (NSW Resources Regulator)

[MDG1020 Underground emergency escapes](#) (NSW Resources Regulator)

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

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

[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)

[Critical Control Management Implementation Guide \(2015\)](#) (International Council on Mining and Metals)

[Mines Safety and Inspection Regulations 1995 \(WA\)](#)