NSW Resources Regulator

TARGETED ASSESSMENT PROGRAM

Consolidated report – Fall of ground risks in NSW underground metalliferous mines

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Contents

Executive summary

The targeted assessment program (TAP) commenced in July 2016 providing 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 (WHS (M&PS) Regulation).

This interim report summarises the findings of assessments undertaken in relation to the mines' management of the principal hazard of ground and strata failure. These assessments were undertaken between July 2016 and August 2017 at 11 underground metalliferous mines in NSW.

The targeted assessment is an in-depth look at the control measures for ground and strata failure and their implementation.

The findings of the assessments are grouped into those that are specific to the principal hazard of ground and strata failure, and those that could be generally applied to all aspects of critical control measure implementation.

General findings highlight there is a need for mine operators to adequately assess risks in the management of ground and strata failure and draw-points as required under clause 9 of the 2014 WHS (M&PS) Regulation. A number of operations either had not conducted a risk assessment relating to the management of risks arising from ground or strata failure or, where they were conducted, were considered by the assessment team to be inadequate.

During the assessment, a number of innovative ground support and monitoring practices were identified that could potentially be applied at all operations. Improved knowledge sharing between operations will only serve to improve safety across the sector.

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 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 three elements:

- a desktop assessment of compliance against legislation with respect to Schedule 1, clause 1 "Ground or strata failure" of the WHS (M&PS) Regulation
  - adequacy of the operation's ground control management plan
  - adequacy of the operation's seismic hazard management plan
- a workplace assessment of the implementation of ground control management plan and seismic hazard management plan
- a workplace assessment of contractor management against clauses 19-22 of the WHS (M&PS) Regulation.

The focus of the TAP was on how operations managed the risks associated with ground or strata failure. This included a review of all documented procedures and systems of work, followed by an assessment of those systems of work in practice.

The assessment considered all aspects of ground or strata risk and how the risk was considered from the earliest stages of mine planning, through to a backfilled stope. It also considered how operations managed ground and strata risks in both a development and a production setting.

The management of contractors and the introduction of equipment to site were also considered within the assessment.

The process

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

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.

Ground and strata control

In accordance with clause 24 of the WHS (M&PS) Regulation, the operator of a mine must prepare a principal hazard management plan, which must provide for management of all aspects of risk control in relation to ground and strata failure.

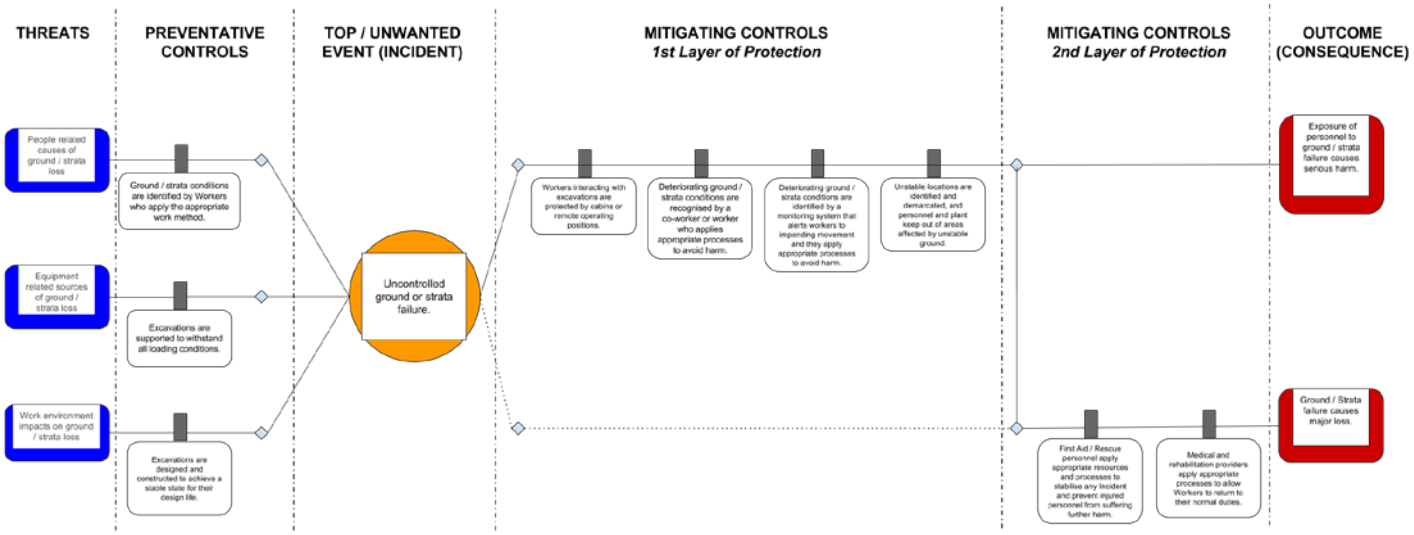
Operators of a mine or petroleum site are also required to:

- manage the risks associated with unplanned falls of any rock by conducting a risk assessment in accordance with clause 23 of the WHS (M&PS) Regulation and considering the matters listed in Schedule 1, clause 1 of the WHS (M&PS) Regulation.
- manage risks to health and safety associated with mining induced seismicity and adopt, as far as is reasonably practicable, an effective seismic monitoring plan which contains trigger or action points to ensure that actions or procedures are undertaken on the occurrence of certain criteria specified in the plan (Clause 44B of the WHS (M&PS) Regulation).
- ensure adequate training to the workforce regarding the implementation of the ground control management plan and the seismic hazard management plan in accordance with clause 104 of the WHS (M&PS) Regulation.
- ensure that contractors on site have complied with clause 22 of the WHS (M&PS) Regulation and have either adopted the safety management system for the mine and given the mine operator written notice of this, or has provided a contractor health and safety management plan and obtained written notice from the mine operator that the plan is consistent with the safety management system for the mine.

Bow-tie risk assessment

When developing this targeted assessment program, the Resources Regulator team completed a bow-tie risk assessment of ground or strata failure. This 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 targeted assessment of ground or strata failure risks identified significant variations in how operations managed the risks associated with ground and strata failure.

The assessment process identified that:

- operations should review processes for managing contractors to ensure that it is clear under whose systems of work the contractor will work and that written notice has been provided by the mine operator and/or the contractor regarding either consistency of the contractor health and safety management plan or adoption of the mine's safety management system by the contractor.
- the process for the introduction of equipment to site needs to be applied consistently. At three operations diamond drill rigs were found to have operators working close by a rotating drill string, with no guarding or proximity switches.
- risk assessments particularly around systems of work in and around draw-points are often not conducted or are conducted poorly. Clause 9 of WHS (M&PS) Regulation requires all systems of work to be supported by an appropriate risk assessment by a competent person(s).
- excessive overbreak was encountered in a number of operations. Overbreak was often found to be wrongly calculated and poorly reported. Mining beyond design impinges on pillar widths, requires greater ground support to be installed and for ore drives, causes drawpoints to be unnecessarily larger.
- the risk of material rilling uncontrollably from stopes is managed largely via bunds. At 70% of the operations assessed, interviews with the workforce and supervisors revealed confusion as to the operation's required bund heights.
- there are a number of innovative practices occurring in operations within NSW around the management of ground or strata failure, yet operations rarely share their learnings with each other. It is recommended operations continue to collaborate around innovative practices to further reduce the risks of ground or strata failure.

- operations were found to be slow to update their systems of work to comply with the new legislation that came into effect on 1 February 2017 and the development of a principal hazard management plan for ground or strata failure (Clause 24 of the WHS (M&PS) Regulation).
- Jumbo operators play a critical role in ensuring the integrity of roof support. At many operations planned task observations or workplace assessments of support installation work did not occur, and at operations where they were undertaken, documented outcomes of these observations and assessments lacked appropriate detail.
- although seismically active operations were found to have adopted a number of appropriate practices in determining seismic risk, it was found that unexpected events had occurred on planes of weakness that had previously been identified as being benign. Seismically active mines need to critically evaluate the seismic potential of faults no matter how benign they may appear.

General findings

Areas of good practice

The assessment process revealed the following areas of good practice:

- Generally operations were found to have well understood re-entry processes post firing and restricted access to unsupported ground.
- Operations used downholes wherever possible in preference to upholes for open stoping, to limit worker exposure to drawpoints.
- There were clear systems in place at all mines assessed to communicate adverse ground conditions, with workers empowered to install additional support or scale as required.
- In general quality control and quality assurance of ground support was found to be well managed, however some operations failed to conduct appropriate testing of fibrecrete.
- Interviews conducted on site found workers to often be experienced miners who had worked at a number of operations.
- Where seismicity was present, its risks were generally well understood by the workforce, with management providing regular and relevant training around seismicity and how it is managed.
- Where seismicity was present mines were also found to have appropriate trigger action response plans and an appropriate network of geophones to provide a live measure of seismicity.
- Operations were found to have good training programs for workers.
- Third party consultants were often used to review ground support regimes and model the seismic potential of an operation.

Risk assessments

Issue	Response
The risk assessment for the ground control management plan, the seismic hazard	Mine operators have a duty under clause 34 of the Work Health and Safety Regulation 2017 to identify reasonably foreseeable hazards that could give rise to risks to health and safety and a duty under clause 9 of the WHS (M&PS) Regulation to conduct a risk assessment for each

management plan and systems of work around drawpoints had not identified all the hazards at the mine.	identified hazard. Mine operators must keep a record of each risk assessment and the control measures implemented to eliminate or minimise any risk that was identified through the risk assessment. All documentation around a system of work should directly reference the risk assessment that it is based on.
Risk assessments did not adequately identify the controls to eliminate or minimise the risks posed by ground or strata failure.	It was often found that controls were adapted and therefore compromised to satisfy a system of work. By way of example one mine set the height requirement of bunds to be 2m high when charging a stope but only 1.5m high and the same distance back from the brow when conducting a cavity monitor survey. The mine advised this was due to the difficulty of conducting the survey with a 2m high bund. If the risk assessment identifies a critical control, then systems of work should be adapted around this control.

Contractor management

Issue	Response
Mine operators were found not to have developed, or have poorly developed, contractor management plans, where the mine operator and the contractor have written agreement as to the safety management system under which the contractor will work.	Under clause 22 of the WHS (M&PS) Regulation the contractor cannot operate without first agreeing with the mine operator upon the safety management system to be used. At a number of operations, the contractor management plan was either in draft format, not developed or there was no written agreement in place to confirm the safety management system the contractor was working under.

Specific findings

Management of drawpoints

Issue	Response
Bunding is used as a critical control to manage the risk of material rilling from a drawpoint, yet there is often a poor understanding among the workforce as to what is the bunding standard.	Clause 104 of the WHS (M&PS) Regulation requires the mine operator to ensure each worker is trained in the implementation of control measures relating to the work being carried out by the worker. Workers need to clearly understand bunding requirements. Section 19(3)(f) of the *Work Health and Safety Act 2011* (WHS Act) requires the mine operator to provide appropriate supervision. Mine operators must ensure that supervisors enforce bunding standards

	across their operation and that the critical control of a bund is not eroded.

Overbreak

Issue	Response
Mining beyond design.	Clause 44B(2)(c) of the WHS (M&PS) Regulation requires the mine operator to ensure, so far as is reasonably practicable, that the design of the mine mitigates the damage arising from the sudden release of energy from the build-up of mining-induced stresses (i.e. a seismic event). It was observed that some operations were mining a 46% larger void than designed. Of the mines identified as having issues with overbreak, on average a 25% larger void was being created in development than was designed. Overbreak should be properly accounted for via monthly survey reconciliations. It was found at multiple operations that the overbreak calculations were incorrect, with designed voids being based on a square profile, rather than arched. This overcalls the designed mining void, therefore undercalling overbreak. Mine operators should provide appropriate levels of supervision to ensure that mining is carried out in accordance with mine design parameters.
Drawpoints greater in area than designed.	For systems of work in and around drawpoints, most operations assumed that drives were mined to their designed dimensions. When drives experience large scale overbreak, they are no longer at these designed dimensions. At one operation that experienced overbreak, bunding heights were relative to the height of the backs, rather than the floor to account for this overbreak If operations are going to experience overbreak, they should review their systems of work in and around drawpoints to ensure the system of work is suitable for the actual, not designed drive dimensions.

Seismic potential of faults

Issue	Response
Operations had not adequately assessed the seismic potential and risk of faults.	Clause 44B WHS (M&PS) Regulation requires mine operators to adopt, so far as is reasonably practicable, an effective control plan for the management of seismicity. Two significant seismic events occurred during the TAP, with each of these events caused in part by the mine operator failing to identify the seismic potential of geological structures in the mine. Structures that were considered to be benign were the cause – in part of these events.

	Mine operators need to regularly assess the seismic potential and risk of geological structures, with reference to the future mine plan, to reduce the risk seismicity poses to workers.

Unauthorised equipment onsite

Issue	Response
Equipment that did not meet a recognised site standard was allowed onsite.	On three separate operations it was observed that contract diamond drillers were operating without adequate controls to prevent a worker accessing the spinning drill string. In each case, the mine operator had an introduction to site process for equipment to be assessed before being granted entry to site. This process was supposed to prohibited equipment from having moving components that a worker could access, however at each site the diamond drill rigs were still placed into service. Under section 19(3)(b) of the WHS Act the mine operator must ensure, as far as is reasonably practicable, the provision of safe plant.

Tracking of hazards

Issue	Response
Operations had no clear system to address uncontrolled hazards reported by mine workers.	At two operations the mine operator did not have an established system for addressing hazards raised by mine workers. Mine operators should consider a system where hazards identified and reported by workers can be clearly tracked and accountabilities assigned. Mine operators must ensure, as far as is reasonably practicable, that the health and safety of workers and other persons is not put at risk from work carried out at the mine (Section 19 WHS Act).

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 Mine Safety inspectors. In summary, these findings are:

Notice	In relation to
Improvement notices, s 191	• contractor health and safety management plans • bunding standards and the underlying risk assessments • no barrier between workers and rotating diamond drill string
Notices of concern, s 23	• risk assessments for the development of the ground control management plan and the seismic hazard management plan • the management of documentation and ability to produce documents in a timely manner • only taking quality control and quality assurance samples of pastefill from surface batch plants and not from the actual stope • conduct a change management process whenever a mine undertakes a major change in mining method • conduct task observations on jumbo operators to monitor for compliance to the mine operator's systems of work • introduction of equipment to site

All mine operators involved in this targeted assessment have indicated that they would respond to the notices and other issues identified through the inspections. Where significant issues were identified, these will be followed up with the individual mines.

The TAP process identified many common issues around the approach taken by the sites regarding managing the risks associated with ground or strata failure. 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 will review their procedures and practices in consideration of the findings of this summary.

Issued by

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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	mine.safety@industry.nsw.gov.au
Phone	02 4931 6666
Incident reporting	To report an incident or injury call **1300 814 609**
Website	resourcesandenergy.nsw.gov.au/safety
Address	Resources Regulator 516 High Street Maitland NSW 2320

Appendix A: Legislative requirements relating to ground or strata failure

The appendix provides a list of legislative requirements referred to in this report in the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014, the *Work Health and Safety (Mines and Petroleum Sites) Act 2013*, the Work Health and Safety Regulation 2017 and the *Work Health and Safety Act 2011*.

Legislation, section/clause	Legislative requirements
WHS (M&PS) Regulation, clause 9	Management of risks to health and safety
WHS (M&PS) Regulation, clauses 19-22	Contractors
WHS (M&PS) Regulation, clause 24	Principal hazard management plans
WHS (M&PS) Regulation, clause 44B	Mining induced seismic activity
WHS (M&PS) Regulation, clause 52	Ground and strata support
WHS (M&PS) Regulation, clause 104	Information, training and instruction
WHS Regulation clause 34	Duty to identify hazards
WHS Act section 19	Primary duty of care
WHS Act section 191	Issue of improvement notices
WHS (M&PS) Act section 23	Notifying mine operator of concerns