NSW GOVERNMENT

NSW Resources Regulator

PLANNED INSPECTION PROGRAM

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Executive summary

A crucial part of the NSW Resources Regulator's Incident Prevention Strategy involves targeted assessment and planned inspection programs for mines and petroleum sites. This is a focus on assessing an operation's control of critical risks through evaluating the effectiveness of control measures in the mine's safety management system.

We developed a bowtie hazard management framework and standardised assessment checklist for each program plan. Under each program plan, the effectiveness of the safety management system at each mine site is assessed against a standard set of control supports and critical controls.

This report summarises assessment findings from 16 mines in relation to assessments for the principal hazard of inundation or inrush of any substance conducted during the period from October 2020 to April 2021.

The threats and critical controls assessed for the material unwanted event of inundation or inrush of any substance are shown in Table 1.

Note that not all critical controls were applicable at all mines.

Table 1. Threats, consequence and critical controls for the material unwanted event –inundation or inrush of any substance – below surface metalliferous mines

THREAT OR CONSEQUENCE		CRITICAL CONTROL
Threat	Accumulation of fluid	PC1.1 – Minimise magnitude of fluid source PC1.2 – Design fluid pathways
Threat	Containment failure	PC2.1 – Containment design and construction
Consequence	One or more fatalities	MC1.1 – Restrict access to inundation or inrush zones

Legislative requirements and published guidance relating to the principal hazard of inundation or inrush of any substance is listed in Appendix A. Figure 1 presents safety compliance findings for each de-identified mine and critical control assessed for the material unwanted event of inundation or inrush of any substance. Explanatory notes on the assessment system are also listed in Appendix B.

Key Findings

Some of the key findings that were discovered during this program plan included:

- some mines had failed to incorporate dam break studies and relevant rainfall data into determining the magnitude of the inrush and inundation risk at the mine
- some mine operators did not consider Clause 36 of the WHS Regulation 2017 and the hierarchy of controls when bogging raise bore cuttings during raise bores development
- some mines developed clear exclusion zones when installing paste or hydraulic fill into stope voids
- mines that adopted paste and hydraulic fill systems for backfill, demonstrated good quality assurance and quality control (QAQC) processes and monitoring of the paste or hydraulic fill as it cures
- not all workers were trained in the use of exclusion zones for paste and waste fill fluid path and where it will travel
- not all mines had a clear egress from ore/waste passes, a reconciliation process, or conducted periodic cavity surveys of ore/waste passes
- remnant mining in old workings requires a thorough risk assessment process and well enforced controls, which was not applied in some cases
- both the risk assessment for inundation and inrush, as well as the Principal Hazard Management Plan (PHMP) were often lacking detail and did not satisfy all of the legislative requirements.

Recommendations

Recommendations which are a result of the inspections conducted included:

- Mine operators should develop clear exclusion zones when installing paste or hydraulic fill into stope voids.
- Mine operators should use remote bogging techniques when removing raise bore cuttings in raises where there is a risk of inrush.
- Mine operators must include all appropriate persons in the inrush and inundation PHMP risk assessment. At a minimum, for underground metalliferous mines this should include a surveyor, a geotechnical engineer, a mining engineering manager underground non-coal, and mine workers.
- Once mine operators have completed a comprehensive investigation and analysis of all aspects of the risk of inrush and inundation, they must develop a PHMP for inrush and inundation. The PHMP must detail all the controls identified in the risk assessment. The mine operator should then ensure the PHMP satisfies all elements of WHS(M&PS) Regulation 2014, Clause 24, 45, and Schedule 1 (2).

Introduction

The NSW Resources Regulator's planned assessment programs provide a planned, risk-based and proactive approach to assessing how effective an operation is when it comes to controlling critical risk. These programs apply the following principles:

- a focus on managing prescribed 'principal hazards' from the Work Health and Safety (Mines & Petroleum Sites) Regulation 2014
- evaluation of the effectiveness of control measures implemented through an organisation's safety management system and
- consideration of the operation's risk profile.

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

Scope

Planned inspection programs include two assessment types:

- targeted assessments, incorporating:
  - desktop assessment of:
    - compliance against legislation with respect to the management of health and safety risks associated with inundation or inrush of any substance – see Appendix A for details
    - the definition of the controls the mine utilises to prevent and mitigate the risks to health and safety associated with inundation or inrush of any substance.
  - a workplace assessment of the implementation of those controls through the inspection of plant and worker interviews.
- planned assessments, which involve a workplace assessment of the implementation of controls through the inspection of plant and worker interviews only.

The process

The process for undertaking an assessment under a planned inspection program generally involves the following stages:

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

Assessment findings

Threats/consequences and controls assessed

Threat:

- Accumulation of fluid

Critical control: PC 1.1 – Minimise magnitude of fluid source

Control objective: Eliminate or reduce the stored energy available to an inundation or inrush event.

Performance requirement:

- risks associated with inundation and inrush are identified
- procedures describe how potential inundation and inrush hazards are identified
- procedures describe how the risk posed by identified inundation or inrush hazards is assessed
- procedures direct a hierarchy of controls approach to eliminating or reducing the inundation or inrush risk
- inundation and inrush sources are identified
- inundation or inrush risk treatment options are evaluated, selected and implemented
- inundation and inrush information, training and instruction is provided.

Specific findings for this critical control included:

- Where it is reasonably practicable to implement, mine operators should investigate the use of paste fill as a backfill material. Paste fill has the potential to reduce the size of tailings dams, reduces the number of pieces of mobile plant required underground, cures faster and is more viscous than hydraulic fill.
- Some mine operators did not have clearly defined systems to ensure that, where possible, known aquifers or sources of fluid or gas underground are not breached.

- If a mining process identifies known inrush or inundation hazards , mine operators must conduct a separate risk assessment utilising the hierarchy of controls to manage the risk. This could potentially include remote systems of work and demarcating inrush zones..
- Some mine operators did not have a documented system for monitoring pumps and gas drainage systems to minimise the magnitude of a fluid source.
- Some mine operators did not consider dam break studies, surface topography, extreme rain events and emergency egresses in both the PHMP, and the risk assessment that supports it.

Critical control: PC 1.2 – Design fluid pathways

Control objective: Prevent the accumulation of fluid that could become an inundation or inrush hazard.

Performance requirement:

- procedures describe how inundation or inrush hazards arising from compromised fluid pathways are identified and assessed
- potential fluid pathways are identified
- fluid pathway inundation or inrush potential is identified
- fluid pathways are designed
- fluid pathways are installed or constructed to the design criteria
- the condition and performance of fluid pathways is monitored.

Specific findings for this critical control included:

- Mine operators must consider not just the portal, but all relevant shafts and old workings in the inrush and inundation risk assessment process and ensure that appropriate barricades and/or drains are installed around any access point to underground workings. Any drain or barricade must be designed to a standard and consider the magnitude of any inrush or inundation hazard, including extreme weather events and dam break studies.
- Mine operators were found to have good processes in place for the management of diamond drill holes. All operations could demonstrate holes are logged and confirm grouting status.

Threat:

- Containment failure

Critical control: PC 2.1 – Containment design and construction

Control objective: Isolate the stored energy of the inundation or inrush hazard from people.

Performance requirement:

- procedures describe the inundation or inrush containment design considerations
- containment structure locations are selected considering potential downstream impacts
- downstream impacts of a containment structure failure are understood and mitigated
- inundation or inrush containment structures are designed for long term stability under worst case conditions
- inundation or inrush containment structures are constructed to the required design
- changes in the magnitude of the inundation or inrush hazard are detected
- deterioration of containment structure integrity is detected
- inundation or inrush containment structures are maintained in a fit for purpose condition
- inundation and inrush information, training and instruction is provided.

Specific findings for this critical control included:

- Paste and hydraulic fill walls were found to be designed and installed to a standard and mine operators could demonstrate a QAQC process for their installation.
- Mine operators could demonstrate a monitoring program for paste and hydraulic paste walls, including drain holes, piezometers and live video cameras that are monitored from the surface.
- Operations engaged in remanent mining could demonstrate systems of work to manage the risk of inrush, including detailed plans issued.
- Mine operators had failed to include surveyors and include controls for managing survey error in the PHMP and its supporting risk assessment.

Consequence:

- One or more fatalities

Critical control: MC1.1 – Restrict access to inundation or inrush zones

Control objective: Eliminate the exposure of people to an inundation or inrush event.

Performance requirement:

- risks associated with inundation and inrush are identified
- procedures describe how potential inundation and inrush hazards are identified
- remote systems of work eliminate people being exposed to inundation risks
- people are prevented from entering areas where an inundation risk is present
- access to established inrush control zones is restricted
- people who work on processes or in areas where an inundation or inrush hazard exists understand the access restriction requirements.

Specific findings for this critical control included:

- Mine operators rely on the administrative controls of signage and training to ensure inrush zones are not breached. Workers and supervisors interviewed all demonstrated knowledge of inrush zones. It is recommended however that the use of inrush zones be discussed in worker inductions in addition to discussion in crew safety meetings and pre-start meetings.

Findings by mine

The figure below presents aggregate assessment findings by critical control, providing a summary view of the status of each mine's hazard management processes. Importantly, the system recognises the value of fully implemented and documented controls by awarding an additional point if both elements were assessed as present. More details explaining the assessment system are found at Appendix B.

Figure 1. Assessment findings for the planned inspection program – inundation or inrush of any substance – underground metalliferous mines

Notices issued

Of the 16 mines assessed under the inspection program, 10 mines received notices relating to the principal hazard of inundation or inrush of any substance, while some mines received notices in relation to other matters. For the purposes of this report, contraventions related to other matters have been removed from the analysis. The notices issued for inundation or inrush of any substance were examined in detail and Table 2 below lists the notices issued by type and details.

Table 2. Notices issued for the planned inspection program – inundation or inrush of any substance – underground metalliferous mines

NOTICE TYPE	TOTAL ISSUED	NUMBER OF MINES
s.195 prohibition notice	2	2
s.191 improvement notice	17	9
s.23 notice of concerns	5	3
Total	**24**	**10**

Of the combined 24 notices issued, there were some common themes which were apparent throughout the program plan. Table 3 summarises the type of contraventions and outlines the total occurrences encountered. These themes can be related back to the critical controls outlined earlier and identify some trends which are of concern.

Table 3. Notices issued - prevalence of categories of concern

IDENTIFIED CONCERN CATEGORY	TOTAL OCCURRENCES IN NOTICES
Documentation relating to controls for inundation or inrush of any substance (e.g. risk assessments, PHMP, TARPs) not relevant, current, or readily available.	12
Controls identified within the PHMP and associated documentation not implemented, maintained or available.	7
Barriers (e.g. banks, dams, septum geological structures, bunding, windrows, berms) not designed to a standard or not implemented or maintained to that standard.	7
Workers not familiar with sources of hazard or what controls to use.	3
Inadequate sharing of information with other outgoing and incoming underground mine supervisors, shift supervisors, managers and any others, using appropriate channels.	3
Opportunities missed to include competent persons (e.g. surveyor, geotechnical, mining, mechanical engineers, production and maintenance workers) in conducting risk assessment(s) in relation to the hazard.	2
Measurement information for strata monitoring devices either not current or not available.	2
Lack of controls to restrict unnecessary or unauthorised vehicles and persons from entering active production or work areas.	2
Information from strata monitoring devices not routinely used in TARPs for the hazard.	1
Electrical ingress controls (e.g. glands, sheaths, enclosures) not readily available, maintained, appropriate, or installed correctly.	1

Further information

For more information on safety assessment programs, the findings outlined in this report, or other mine safety information, please contact the Regulator.

CONTACT TYPE	CONTACT DETAILS
Email	cau@planning.nsw.gov.au
Incident reporting	To report an incident or injury call 1300 814 609 or log in to the Regulator Portal
Website	https://www.resourcesregulator.nsw.gov.au/
Address	NSW Resources Regulator 516 High Street Maitland NSW 2320

Appendix A. Legislative requirements and published guidance relating to the principal hazard inundation or inrush of any substance

The following is a list of certain legislative requirements for the management of inundation or inrush or any substance 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.

Work Health and Safety (Mines and Petroleum Sites) Regulation 2014:

- Clause 14, Content of safety management system
- Clause 23, Identification of principal hazards and conduct of risk assessments
- Clause 24, Preparation of principal hazard management plan
- Clause 45, Inrush hazards.

Work Health and Safety Regulation 2017:

- Clause 36, Hierarchy of control measures.

Appendix B. Assessment system explained

We use a bowtie framework to proactively assess how mine sites manage their principal hazards. Bowties are a widely used risk management tool that integrates preventative and mitigating controls onto threat lines that relate to a material unwanted event.

As part of program planning, controls were categorised in accordance with the ICMM handbook. Only controls deemed critical[1] are assessed under a planned inspection program. For a control to be assessed as effective, each of its control supports must be in place and operational.

Assessment findings results calculation

During the program, each control support assessed at each mine was rated and the findings recorded. Points were awarded depending on whether there was evidence that the control support had been documented and /or implemented. Importantly, the system recognises the value of fully implemented and documented controls by allocating four points if both these elements were present.

For finding outcomes, points were awarded for each control support identified within a critical control. An overall assessment result for the critical control was then calculated as a proportion of the maximum possible points for that critical control. For example, if a critical control comprises ten control supports and five were assessed as fully implemented (‘documented and implemented’) and five were found to be ‘not documented and not implemented’ then the overall assessment result for that critical control would be 50%.

Table 3. Finding outcome and points

FINDING OUTCOME	POINTS
Documented and implemented	4
Implemented but not documented	2
Documented but not implemented	1
Not documented and not implemented	0

Critical control calculations also took into account instances where control supports were not applicable to the mine being assessed or when control supports were not able to be assessed during a site visit.

[1] Critical Control Management Implementation Guide, International Council on Mining and Metals (ICMM), 2015.

The overall assessment result for each critical control has been assigned a colour based on the assessment bands presented in the table below. The colour band results are then used to identify industry focus areas requiring improvement.

Table 4. Assessment results and colour code

CRITERIA	COLOUR
An assessment result of 100% of possible points	Green
An assessment result of ≥ 80% but < 100% of possible points	Yellow
An assessment result of ≥ 65% but < 80% of possible points	Orange
An assessment result of < 65% of possible points	Red