



INFORMATION SHEET: FOCUS ON COMPLIANCE

Known hazards when conducting raiseboring activities in underground mines

Background

Raisebore drilling is an underground drilling application used to create a vertical or sub vertical circular excavation between two or more levels of a mine, without the use of explosives. It is most commonly utilised for the development of shafts from the surface to underground workings for the purpose of ventilation.

Information obtained by WorkSafe Mines Safety has identified a number of instances where workers have been exposed to the dangers from inrush, cutter or drill string failure and from falling objects while working on or near raisebore activities.

Common hazards include:

- inrush risk: unplanned ingress of water or gas, poor ground and/or inadequate provision of services
- catastrophic drill rod or reamer stem failure resulting in rods and/or head falling to the bottom of the hole or becoming jammed in the hole in an inaccessible location
- exposure to injury from falling rocks or debris while inspecting or changing raisebore head cutters at the bottom of a partially reamed hole.

Hazards that can occur from raisebore drilling

- Hole or ground failure/rock fall (geotechnical failure risk)
- Unplanned ingress of water/mud or gas (inrush risk)
- Drill string failure/pre-mature cutter wear or failure
- Unplanned breakthroughs
- Hazardous dust exposure and dust contamination of mine ventilating air during reaming
- Cuttings removed from the active raisebore hole are dumped and/or stored in unsafe situations
- Ventilation reversals and/or short circuiting
- Crush injury or manual handling injury during reamer assembly and attachment to drill string.

Raisebore designers and operators

- The mine operator must ensure hazards and controls for raise bore activities are included in the risk management processes that form part of the mine safety management system. The contractor's safety management plan must be reviewed and approved and compliance monitored
- The person with management or control of a registered mobile crane must ensure the size and type of crane is suited to the weight and dimensions of the raise drill, drilling equipment and the ground stability where the crane will operate
- Ensure the hole is in the correct location and the drill pad is sufficient for the size of the hole and the ground conditions at the collar
- Any existing excavations are noted and there is sufficient clearance to accommodate potential hole deviations
- The raisebore chamber has adequate space, drainage, ventilation and access/egress for the operator
- There is room for rod storage and handling facilities
- The correct drill and reamer with sufficient cutters has been selected for the rock type
- The provision of project services is adequate
- Dust and airborne contaminants are adequately controlled by use of installed curtains or alternatives
- Waste drill cutting volumes have been calculated and management of cuttings has been defined within operational plans during drilling operations
- Risks associated with non-vertical, longer or larger diameter holes have been minimised
- The risk of a power cut has been considered.

Before raisebore work commences

- Geological, hydrological and geotechnical parameters have been established by a competent person, ground condition parameters meet industry standards and rock properties and the condition of the rock mass is known
- All plans are in place (safety management plans, trigger action response plans (TARP), ventilation plans)
- Management of drill cuttings has been planned and communication with raisebore driller and monitoring of drill progress and drill waste removal is prioritised during back ream drilling
- The reamer can be removed safely
- Installed lifting points have been tested
- Plans for ground support pattern will be reviewed after reamer head excavation is in place
- Drain holes have been pre-drilled prior to reaming
- Procedures have been implemented for cutter inspection and replacement or reamer removal that do not position persons directly beneath an open hole or unsupported ground
- Monitoring and reconciliation of chippings volume being produced versus chippings volume removed is accurate and is undertaken in real time
- Operator fatigue is monitored
- Brow failure does not occur while people are working in the vicinity of the brow.

Risk management to avoid inrush

Inadequate evaluation can result in unplanned water ingress.

- ensure the design and installation of settling ponds, sumps and pumping systems for the raisebore chamber and bottom of the hole are acceptable, and a suitable maintenance program is in place to prevent silt build up
- ensure adequate supply and control of water for drilling operations
- analyse main structures in the projected path of the hole that may bear water
- analyse data from stopes next to path of raise, establishing where the fill is wet, dry, stable or saturated
- during pilot hole drilling, ensure circulation is maintained through a filled stope or development void
- ensure ground water conditions are monitored during drilling
- determine water quality, permeability and rate of water flow of all water encountered and test rock samples for permeability. These results are used for risk analysis of water inflow
- an extended pre-sink should be considered in the case of unconsolidated water bearing material near the collar of the raise and include provision for water to be directed and controlled at the bottom of the raise bored hole in the case of a wet hole
- ensure adequate water storage provision and standby pumping capacity
- ensure TARP is in place for management of hole blockage from drill cuttings.

Controls to avoid danger of rock falls onto workers

- workers should never position themselves beneath a vertical opening
- workers should never approach the brow beyond a predetermined 'exclusion zone' under any circumstances
- erection of barricades and signs to prevent access to high risk areas
- provision of effective lighting
- completion of a risk assessment by all workers involved in working at or in the vicinity of the reamer
- establishment of a 'no go' exclusion zone at the bottom of the hole to minimise or eliminate the risk of injury from ricochet rocks
- ensure TARP in place for unplanned or excessive rock fall during reaming.

Physical shields, curtains and barriers

A physical shield and barriers should be implemented to provide protection to workers from ricochets and falling rocks while working in close proximity to the brow of the open raise bore hole.

Curtains should not be relied upon to provide protection from direct impact from falling rocks or material from within the open raise drill hole when inspecting or changing cutters, or removing a raise bore head. An engineered control should be included to prevent the hazard of rock fall or rock ricochet entering the work area.

The decision to utilise a particular design/configuration of barrier should include consideration of the engineering design specifications of the barrier, the risk of hole deterioration and the most probable case dynamic loading on the barrier.

Where an engineered control cannot be implemented to protect workers involved in the task of inspecting or changing cutters or reamer head removal, the reamer head should be removed from the drop zone to a safe work area i.e. supported ground.

The following incident occurred on a WA mine and is illustrative of potential hazards while working on or near raisebore activities.

- Incorrect geological assumptions were made regarding the ground on which a raisebore was to be installed. The assumptions were based on drill core samples taken in close proximity which didn't match the chosen location of the raisebore.
- As the reamer was raised it hit faulted ground. This dislodged large boulders which landed in the work area underneath the reamer, causing a hazard and several near-misses to the workers in the area. The cutters were also damaged by the rock. Even though curtains were used to protect workers, the weight and velocity of the falling rock knocked the curtains aside and exposed workers to hazards.

WorkSafe recommendations for PCBUs and mine operators at mine sites

- develop a safe system of work for managing these risks and check training and knowledge of safe working procedures
- assess risks of exposure to the hazards associated with these activities
- include the activity in the principle mining hazard management plans (PMHMP)
- supervision and inspections are increased during hazardous activities
- contractor management processes are in place to ensure control measures that will be used to control risks to health and safety associated with the contractor's work are reviewed and agreed
- arrangements for monitoring and evaluating compliance of the contractor with health and safety requirements are in place.

Further information

NSW Resources Regulator

- [MDG 1030 Guideline for raiseboring operations](#)
- [Safety alerts: Water inrush from Raisebore Hole](#)

Safe Work Australia

- [Guide for tunnelling work](#)