Safe drill and blast in surface operations

MinEx

Health and Safety in NZ extractives

Contents

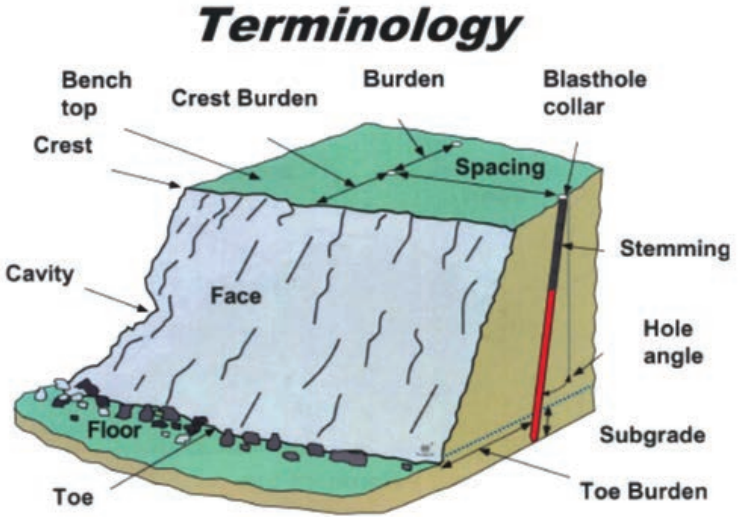
1 Introduction

The use of explosives to break rock involves the sudden application of large amounts of energy and is therefore a process requiring the effective management and control of activities to ensure that hazards are identified and appropriately controlled.

This booklet has been developed to provide practical guidance regarding drilling and blasting activities that must be considered as part of the risk assessment process, and during the development of a health and safety management plan and associated operating procedures and work instructions.

This booklet should be read in conjunction with the MinEx Extractive Industry Safe Drill and Blast in Surface Operations code of practice, the Health and Safety at Work Act 2015; the HSWA (Mining and Quarrying) Regulations 2022 (the Regulations); AS 2187.2-2006 Explosives - Storage, Transport and Use Storage; and the Health and Safety at Opencast Mines, Alluvial Mines, and Quarries Good Practice Guidelines.

2 Terminology



Blast area – The area where blastholes are to be charged and fired, and within which access will be restricted to authorised persons, authorised vehicles, or personnel/vehicles under the supervision of authorised persons.

Blast controller – A person who is appointed and responsible for the logistics of the clearance of the blast exclusion zone, including the removal of personnel and equipment, the positioning of blast guards, and completion of a final sweep prior to firing. In some cases this will be the shotfirer.

Initiating explosives – Any device containing an initiating or primary explosive that is used for initiating detonation in another explosive material.

Principal Hazard Management Plan – The general purposes of the principal hazard management plans are to:

(a) identify the nature of all principal hazards at any mining and quarrying operation, and

(b) set out the measures that will be used to ensure that all principal hazards are effectively managed.

Shotfirer – An appointed person who uses blasting explosives and is responsible for preparing, charging and firing explosives. A shotfirer will be nominated for each particular blasting activity.

Surface delay – A low energy detonator housed in a plastic block that allows for sequencing (timing between initiation of holes) of non-electric blasts for open cut operations.

Stemming – Rock or sand material placed on top of the explosive in a blasthole to reduce the air overpressure levels from a blast.

3 Risk assessment

A risk assessment should be completed for each blast, identifying the hazards and controls at each stage, including the size of the blast exclusion zone required for the shot. Any risk assessment and subsequent hazard controls should be agreed to and approved by all the relevant parties involved in the blasting process before blasting. Factors to be considered during the risk assessment include (but are not limited to):

- Planning and design – Identifying the hazards and controls associated with specific blast types and ground conditions, and the potential impacts on subsequent mining activities, wall stability, environmental impact, downstream processing etc.
- Bench preparation and demarcation – Identifying the hazards and controls associated with equipment and personnel working within the blast area.
- The type of shot and direction of firing, considering the mining/quarrying method, excavation equipment to be used, direction of fire and initiating point.
- Access to/from the blast area, and within the blast area, and the ability to charge and sequence all blastholes to design specifications.
- Likely geotechnical conditions, including groundwater, the presence of voids (either natural or from underground workings), previously blasted broken ground, unstable crests and walls/slopes, or the potential for elevated temperature and/or reactive ground.

Use of explosives (or associated activities) is considered a principal hazard under the Regulations. Sites where explosives are used must have an appointed manager qualified in accordance with the Regulations. A-grade quarrying operations where explosives are used require a Principal Hazard Management Plan for explosives.

4 Contractor management

Contractors and sub-contractors play a major role in supplying drilling and blasting services to the mining and quarrying sector.

The site manager has responsibility for the health and safety of all workers who undertake tasks at the site – full time, part time and casual employees, contractors and their employees, sub-contractors and consultants.

Contractors, in turn must take reasonable care that their acts or omissions do not adversely affect the health and safety of other persons. Contractors and their employees must also comply with any reasonable instruction that is given by the site manager to allow the site to comply with relevant legislation and co-operate with any reasonable policy or procedure of the site relating to health or safety at the site.

5 Blast planning and bench preparation

Effective and safe blasting requires prior planning and scheduling on a daily, weekly, and monthly basis, to ensure that blasting activities can be carried out safely within required timeframes.

Bench preparation is critical in establishing a safe working environment for all activities associated with surface blasting.

Factors to be considered include:

- The blast area is to be defined, designed and scheduled so that drilling, charging and firing requirements can be quantified and scheduled in advance.
- The blast design and plan must consider the equipment to be used to ensure that all blastholes can be safely accessed and drilled to designed depths, angles and orientations.
- The blast area must be available for blasting operations to proceed, without unsafe interaction from other mining/quarrying activities such as excavation and haulage.
- Bench preparation is to be completed on time, to an adequate standard for safe and efficient drilling and charging.
- Sufficient labour and equipment are to be available to complete the blast in the required timeframe, without rushing and allowing time for unforeseen events, adequate checks and record keeping.

6 Drilling blast holes

Blast geometry and design is imperative to create safe discharges and blast results.

Blasthole diameter, inclination and length should be adequately designed and recorded for the selected drill pattern. Correct drilling of blast designs will ensure safety hazards such as over break, fly rock or air blast overpressure are significantly reduced.

The following standards and procedures should be in place:

- The drilling site should be prepared, and drill holes marked before drilling.
- The driller should record every drill hole including date, time, length, inclination, and position relative to a fixed point or benchmark.
- The driller should record any unusual events during the drilling (e.g. cavities, soft rock, or an inability to drill designated holes).
- When positioning the drill rig or while drilling near the edge of the bench, the drill rig should be positioned so the operator has a clear view of the edge at all times and far enough away to prevent the drill rig toppling.
- Drilling should not be carried out in a hole where any part is considered within an unacceptable distance from a hole containing explosives (minimum 2 burdens or spacings lengths).

All rotating and moving components must be guarded to Australian/New Zealand standards. Ensure people working near rotating machinery do not wear loose clothing and do not have loose sweat cloths or cleaning rags on them.

Drill rigs working on a bench

7 Transporting of explosives

Good communication between all personnel within the blast area is required to ensure safe work and to ensure that vehicles do not drive over charged blastholes or initiating explosives. Radio communication and/or hand signals must be understood by all personnel in accordance with the site's Traffic Management Plan.

Bulk explosives delivery records by truck and shift should be kept, that allow reconciliation of actual and design densities and quantities, of explosive products used, and identification of which holes were loaded by which truck. The manifests carried on any vehicles carrying initiating explosives should enable reconciliation of explosives stock.

8 On-bench practices

The measuring and priming process requires the handling and management of sensitive initiating explosives and must be carried out by authorised and appointed personnel. This part of the blasting process must be conducted in a controlled, sequential manner to facilitate the tracking of explosives usage, and minimise the risk of damage/impact to initiating explosives from vehicles in the blast area.

Any workers handling or using explosives must be competent (hold Certified Handler / CSL) or strictly always supervised by a certified handler. A certified handler is someone who has been certified to handle very hazardous substances.

All blastholes must be measured prior to charging. Blastholes are to be measured with a suitable (non-ferrous) weighted measuring tape or cord, of adequate length, to measure the deepest blastholes.

Initiating explosives used in blasting need to be compatible with each other, with the bulk explosives used and with the environment in which the blasting is to be carried out. Boosters and detonators must be kept separate until assembled as primers immediately prior to placement in the blasthole.

The charging and stemming process requires close attention to quality control, in terms of charge quantities, column rise, and stem height. Equally important is the need for safe on-bench traffic management, in terms of the interaction between equipment and personnel and the use of large equipment close to charged blastholes and initiating explosives.

Blasthole loading is to be sequenced in such a manner that water displaced from wet holes does not run into previously loaded dry holes, or (where possible) create boggy conditions in areas still to be loaded.

Stemming should be placed to design depths with previous bulk explosive column height checked after charging. Stem heights should be recorded to a specified accuracy, consistent with a safe and environmentally acceptable blast design.

Appropriate stemming material (size, type and quality) must be used. If aggregate stemming is specified, but not available, an increased length of drill cuttings may be required (dry holes only) to achieve adequate confinement and must be authorised by the shotfirer or relevant site representative.

9 Surface tie-up

The sequencing of blastholes permits the controlled release of explosive energy in a manner that provides the required level of confinement and burden relief to achieve the desired fragmentation and blast movement, while minimising the risk of undesired outcomes such as flyrock, overpressure, vibration, noise, misfires and poor fragmentation.

Careful consideration should be given to the following:

- All non-essential vehicles must be removed from the blast area prior to the placement and connection of surface delays under the supervision of the shotfirer;
- Surface delays should be placed on the same side of each blasthole in line with the row to assist in their visibility;
- Slumped holes must be topped up with stemming or drill cuttings immediately prior to tie-up where possible and recorded;
- Recording and reconciliation of the quantities of surface delays are to be carried out against the quantities specified in the blast design, and the quantities issued from and returned to the magazine, in order to identify correct usage and unexplained losses.

The lead-in-line can be placed at the initiation hole but must not be connected until the blast exclusion zone has been cleared and secured to prevent inadvertent access.

10 Blast clearance, blast guarding and firing the shot

Blast notification, clearance and shotfiring procedures must be carried out in accordance with the site blast management system. A number of factors associated with blasting work will, however, require additional consideration when determining clearance distances, guard locations and shotfiring position. These must be communicated to, and agreed with the blast controller and include the following:

- Are there any over-loaded or under-burdened holes that could not be rectified?
- Were any potential misfire risks identified during charging, that have not been rectified?
- Does the presence of broken ground increase the risk of flyrock, overpressure or fume, from otherwise apparently well contained areas?
- Is the blast in an area with a known history of generating post-blast fume?
- Is the blast in a hot/reactive area? Can the shot be fired in the necessarily short 'load and shoot' time that may be required?
- Are there any ground stability issues that will require further assessment after the blast has been fired and delay re-entry?
- Are multiple shots in the vicinity of each other being fired by one or more shotfirers in the same firing window? Ensure clearance zones reflect the multiple shots, ensure all blasting devices are secured if re-entry to a particular shot is required, and consider the impact one shot may have on another with respect to the initiating systems used, and the sequence in which they will be fired.

Any and all variations to the blast, or measures undertaken to limit risks of potential hazards during blasting, should be agreed, recorded and signed off by the blast controller or relevant mine representative.

11 Post-blast assessment and reporting

Post-blast risk assessment takes place AFTER the shot has been fired. It is essential in order for safe work to resume in the vicinity of the blast and elsewhere within the blast exclusion zone.

The site should have a documented blast hand-over process, such that any relevant misfires or blast related hazards are communicated by the shotfirer to the relevant supervisor, and effectively communicated/ demarcated for other personnel until rectified.

All relevant documentation associated with blasting activities needs to be completed in accordance with site and/or company procedures wherever relevant.

12 Treatment of misfires

All sites must have a written procedure that provides a safe system of entry and inspection for misfires and their treatment including the methods used for detecting a misfire.

Where a misfired charge is identified the approved handler must ensure no-one approaches for 10 minutes in the case of an electrically fired charge. For a charge fired by a fuse this is 60 minutes. The certified handler must then safely depose of the malfunctioning charge in accordance with the Health and Safety at Work (Hazardous Substances) Regulations 2017.

Useful Resources

Extractives Safe Drill and Blast Code of Practice (MinEx guidance 2023)

Code of Practice – On-bench Practices for open cut Mines and Quarries (Australasian Explosives Industry Safety Group Inc. 2019 (AEISG))

Health and Safety at Opencast Mines, Alluvial Mines, and Quarries Good Practice Guidelines (WorkSafe NZ)

AS 2187.1-1998 Explosives – Storage, Transport and Use (Australian Standard)

Health and Safety at Work (Hazardous Substances) Regulations 2017 (WorkSafe NZ)

Blast Monitoring

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www.minex.org.nz