



Australasian Explosives Industry Safety Group Inc.

Code of Practice

ON-BENCH PRACTICES FOR OPEN CUT MINES AND QUARRIES

**Edition 3
June 2019**



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About AEISG

The Australasian Explosives Industry Safety Group (AEISG) is an incorporated association of Australasian explosives manufacturers and suppliers originally formed in 1994.

Since then, AEISG membership has grown substantially to include most of the Australasian explosives industry. A full list of all current member organisations can be found on the AEISG website, www.aeisc.org.au

The goal of AEISG is to continuously improve the level of safety and security throughout our industry in the manufacture, transport, storage, handling and use of explosives and related materials.

One of the strategies adopted by AEISG in this regard is to identify areas where improved and consistent standards of operational safety and security need to be applied, and then develop appropriate codes which reflect industry best practice in these areas.

AEISG codes of practice are adopted by members for the benefit of their employees, their customers and the general community. In the interest of promoting safety and security, the codes are freely available on the AEISG website.

To keep abreast of technological advancements, industry progress and regulatory changes, AEISG codes of practice are subject to regular review and updated through the issue of amendments or revised editions as necessary. It is important that users ensure they are in possession of the latest edition and aware of any amendments. References to superseded versions should be updated accordingly.

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Contents

Preamble	5
1.0 Scope	6
2.0 Definitions	7
3.0 General Requirements	10
4.0 Risk Assessment	13
5.0 Blast Planning and Record Keeping	17
6.0 Bench Preparation and Demarcation	21
7.0 Measuring and Priming Blastholes	25
8.0 Charging and Stemming Blastholes	34
9.0 Surface Tie-Up	40
10.0 Emergency Response	43
11.0 Blast Clearance, Blast Guarding and Firing the Shot	44
12.0 Post-Blast Assessment and Reporting	45
Appendix A	47
Appendix B	48
Appendix C	51

PREAMBLE

AEISG Inc. has identified the need to provide guidance on establishing best practice systems and procedures for managing on-bench procedures for the loading and firing of blasts at open cut mines and quarries, to minimise risks for its members, its clients, their employees and the wider community.

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. On a mine or quarry site the potential hazards are increased by the need to handle sensitive initiating explosives while working in a harsh environment. The blasting process must be managed in a way that minimises the risk of the unplanned detonation of explosives, and associated undesired outcomes, and uncontrolled blast behavior at the time of firing.

In considering the safety of mine personnel, contractors and the general public, hazards associated with the blasting process include, but are not be limited to, the following:

- Loss or theft of explosives from the mine/quarry site, representing a security risk;
- Unplanned detonation of explosives due to incorrect handling or application, or during transportation;
- Unplanned detonation during placement due to impacts associated with operating equipment (e.g. as drills and excavators in adjacent areas); impact from passing equipment; or snap-slap-shoot risks from passing equipment;
- Unplanned detonation of explosives after placement, from an external source of initiation such as hot/reactive ground, or lightning;
- Unplanned detonation of explosives due to the application of electrical energy for testing or firing of electronic initiation systems, e.g. following undetected damage by lightning;
- Flyrock risks to persons, equipment and infrastructure, outside the blast exclusion zone, generated by an inadequately confined blast, within a blast exclusion zone that has not been adequately cleared prior to firing, or an exclusion zone inadequately determined based on ground conditions;
- Environmental compliance risks (overpressure and ground vibration) associated with overloaded blastholes, large (reinforcing) blasts, and unfavourable meteorological conditions;
- Persons at risk from dust and fumes generated by the blast, outside the blast exclusion zone or potentially outside the site boundary;
- Persons at risk from misfired blastholes, particularly during subsequent excavation or re-drilling of the blast area.

This Code has been developed to provide practical guidance regarding those on-bench activities that must be considered as part of the risk assessment process, and during the development of a safety management plan and associated operating procedures and work instructions. The Code is necessarily generic in order to remain applicable across a broad range of applications, using a variety of explosive products, to achieve different blasting outcomes. It is understood that specific blasting practices and applications vary significantly across open cut coal operations, open pit metal mines and quarries, and therefore, a review of these guidelines must be carried out for applicability on a site-specific basis. In the event of any conflict between this Code and applicable regulatory requirements, the regulations shall always take precedence.

The information is provided in good faith and without warranty.

1.0 SCOPE

1.1 This Code sets out recommendations and precautions to ensure the safety of employees, sub-contractors, members of the public and the environment, in relation to activities associated with the blasting process. These recommendations principally apply to 'on-bench' activities, including the preparation of a blast area, the priming and charging of blastholes, stemming and the tie-up of charged blastholes ready for firing.

1.2 This code does not cover the detailed requirements for the safe and secure storage and transport of explosives and security sensitive materials, as would be described under a site security plan. It is assumed that explosives and security sensitive materials will be managed in accordance with a risk assessed management plan, a site security plan, and associated operating procedures and work practices.

1.3 This code does not cover those activities associated with the firing of the shot, including blast notification, setting of blast guards, clearance of the blast exclusion zone, firing the shot, post-blast clearance, or misfire management. These are described in the AEISG Code of Good Practice, "Blast Guarding in an Open Cut Mining Environment".

Note: The potential for undesired blasting outcomes at the time of firing needs to be considered whilst carrying out on-bench activities.

1.4 This code does not cover the management of hot and/or reactive ground, other than to the extent that general safe blasting practices must be observed for blasts. Specific guidelines when managing blasting in hot and/or reactive ground are provided in the AEISG Code of Practice, "Elevated Temperature and Reactive Ground".

1.5 This code does not cover the management of post-blast fume, other than to the extent that the correct implementation of the blast design, appropriate explosives selection and water management, and good blast management will minimize the potential for post blast fume. Specific guidelines for preventing and managing post-blast fume are provided in the AEISG Code of Practice, "Prevention and Management of Blast Generated NO_x Gases in Surface Blasting".

1.6 This code does not cover the operational use of any specific bulk equipment, such as Mobile Processing Units (MPU's), stemming equipment, dewatering equipment, or any systems for the measurement, monitoring or firing of blasts. Use of specific equipment, on (or near) bench loading activities, must be in accordance with the manufacturer's/supplier's recommendations and guidelines, and site management systems and procedures, including relevant traffic management plans and any identified exclusion zones. The requirements for the design and operational management of Mobile Processing Units (MPUs) can be found in the AEISG Code of Practice, "Mobile Processing Units".

2.0 DEFINITIONS

Definitions used within this Code where applicable are consistent with the meanings as defined in AS2187.0

Associated Works – Facilities such as magazines, process buildings and storages of energetic materials such as Ammonium Nitrate, Emulsions/Water-gels (ANEs) or other dangerous goods.

AN – Ammonium nitrate

ANE(s) – An ammonium nitrate emulsion, suspension or gel used as a precursor for the manufacture of explosives.

Bench – A ledge, which, in open-pit mines and quarries, forms a single level of operation above which mineral or waste materials are excavated from a continuous bank or bench face. The material or waste is removed in successive layers, each of which is a bench, several of which may be in operation simultaneously in different parts of, and at different elevations in an open-pit mine or quarry.

Bench Height – The vertical distance between the base of one bench and the base of the overlying bench. The bench height is designed by the mine planner. The main constraint on height of bench is usually the limiting thickness that can be handled by the drills and/or the loading equipment.

Berm or Safety Berm – A small horizontal shelf which is usually the remnant of a bench left within the final pit wall slope. The primary purpose of a safety berm is to catch small rocks falling off the sides of the pit walls, to provide access for drainage, and for general slope stability. Berms may be wide enough for light vehicle access (five to ten metres), even if no roads are actually established along them. This allows room for clean-up using small equipment.

Blast Boards – Designated boards located in areas where general mining personnel gather or pass, dedicated to the site blasting activities and indicating the location, time and date of any scheduled blasting on a mine/quarry site.

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. The blast area may also include clearance distances outside the immediate charging area. For example, drilling, excavation and other operations may be restricted, adjacent to, above or in front of the immediate charging area.

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 may be the Shotfirer.

Blast Exclusion Zone – The area that is determined by a risk assessment process, to ensure that all the expected / foreseen effects of the blast, are maintained within a controlled area. The Blast Exclusion Zone can be layered, with an inner zone being defined as the exclusion area for equipment and a wider area being defined as the exclusion area for personnel.

Blast Guard - Industry terminology for a hard barrier consisting of a suitable person and equipment (visual indicators, suitable vehicle and communications equipment), strategically located to prevent access of unauthorised personnel and traffic into a designated Blast Exclusion Zone.

Dynamic Water – The flow of water into or through the blasthole that is sufficient to interfere with the charging process or degrade the explosives column due to its flow. Water is commonly considered to be ‘dynamic’ if recharge occurs after dewatering.

High Wall – The unexcavated face of exposed overburden and coal in a surface mine or in a face or bank on the uphill side of a contour mine excavation.

Lowall – In an open cut coal strip mine, the lowall is the slope of the overburden (spoil) dump, usually directly opposite the highwall, separated by the bench width.

MPU – Mobile Processing Unit (refer AEISG Code of Practice, “Mobile Processing Units”).

Post-Blast Fume – The plume of material generated after the initiation of ammonium nitrate based explosives, which is sometimes a yellowish through to a red/brown NO_x colour.

PPE (Personal Protective Equipment) - Items of clothing or devices worn to protect an individual from the actual or potential risks to health or safety arising from an activity or process.

Pre-Blast Meeting – A meeting sometimes conducted at the edge of the delineated shot, prior to the shot being fired. The meeting should include the Shotfirer, Blast Controller, nominated Blast Guards and other personnel relevant to the blast such as technical representatives and/or supervisors.

Pre-Shift Meeting – A meeting conducted on a site prior to, or at the beginning of, each shift where relevant information is communicated to operational personnel, such as road reports, mining activities, blasting activities, sleeping shots, new hazards, misfires, changes to procedures, etc.

Protected works - The two classes of protected works are as follows:

(a) Class A: Public street, road or thoroughfare, railway, navigable waterway, dock, wharf, pier or jetty, marketplace, public recreation and sports ground or other open place where the public is accustomed to assemble, open place of work in another occupancy, river-wall, seawall, reservoir, water main (above ground), radio or television transmitter, main electrical substation, private road which is a principal means of access to a church, chapel, college, school, hospital or factory.

(b) Class B: Dwelling house, public building, church, chapel, college, school, hospital, theatre, cinema or other building or structure where the public is accustomed to assemble, shop, factory, warehouse, store, building in which any person is employed in any trade or business, depot for the keeping of flammable or dangerous goods; major dam.

Roster/Swing changeover – Refers to the transition from one blasting team to another, working over different roster periods.

Shift changeover – Refers to the transition from one blasting team to another, working on alternating shifts.

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.

Site – indicates mine or quarry site.

Sleeping Shot – A blast area containing explosives that is not yet ready for firing (i.e. loading is incomplete) or has been delayed due to charging constraints or unsuitable conditions (e.g. weather conditions).



Standard Operating Procedure (SOP) / Standard Work Practice (SWP) - A written procedure containing a detailed description of how a task is to be performed.

The SOP/SWP identifies the precautions required to safely complete the task, and should reference required personal protective equipment (PPE); hazards specific to the task and/or site, the level of authority, responsibility and training required to complete the task safely; and reporting relationships that may interact with other activities. The SOP's and SWP's are usually referenced by an overlying safety management plan.

Unauthorised Persons – Personnel not associated with blast charging and shotfiring activities, who are not permitted to enter the blast area without permission of the nominated Shotfirer and then only under appropriate supervision.

Unauthorised Traffic – Personnel operating machinery / vehicles not associated with blast charging and shotfiring operations, which are not permitted to enter the blast area without permission of the nominated shotfirer and then only under appropriate supervision.

Windrow – The berm of material on the edge of dumps for trucks to back to when dumping overburden or along the crest of the highwall to prevent equipment from going over the crest.

3.0 GENERAL REQUIREMENTS

Management systems and procedures which (have been developed using a risk management approach) must be in place to control the blasting process and must satisfy applicable regulatory and organisational requirements. This Code should be used when developing or reviewing management systems that relate to blasting and explosives.

It is the responsibility of site management to ensure all personnel involved in blasting operations are suitably qualified and trained and adhere to all relevant site-specific SOPs/SWPs. It is the responsibility of all persons working on the blast bench to adhere to the relevant site specific Standard Operating Procedures and Standard Work Practices when engaging in on-bench activity.

It is the responsibility of all persons involved in the blasting process to use risk management principles to assess hazards and implement necessary controls for activities or processes, where there is a risk of personal injury or equipment damage. This applies to activities on the blast bench, or to consequences of such activities while the shot is 'sleeping', when the blast is fired, or at some later time.

Prior to the operation of any equipment used in the blasting process, all relevant pre-start inspections must be completed and recorded for all equipment that is used in the operation. Equipment is not to be operated by any person where it is not safe to do so, or where that person is not trained and authorized to do so. Equipment can include MPU's, dewatering and stemming equipment and light vehicles suitable for the transportation of the shot crew and/or explosives.

Where vehicles are used for the transportation of bulk explosives, precursors or initiating explosives to/from the blast area, such vehicles must comply with applicable standards (e.g. Australian Code for the Transport of Explosives by Road and Rail Edition 3, Australian Dangerous Goods Code Edition 7 and Australian Standard 2187.1-1998 Explosives-Storage, transport and use). Such vehicles must be approved for use on site, be clearly identifiable and placarded in terms of the products being transported, comply with the legislative and site conditions and be managed in a manner that prevents unauthorised access to explosives and precursors.

Site-specific guidelines for the transportation and storage of explosives, and secure management and handling of explosives and other security sensitive materials, must be documented within a Site Security Management Plan and associated operating procedures.

3.1 Personal Protective Equipment and Special Equipment for the Task

The personal protective equipment required for the task will be in accordance with the company and site requirements.

Specialised equipment may include:

- (a) Site compliant two-way communication;
- (b) Approved blast area demarcation and road closure items (signage, witches hats, flashing lights, bunting etc.);
- (c) Approved blasthole measuring devices, such as weighted measuring tapes or measuring lines, face profiling devices and blasthole tracking systems;



Face profiling and blasthole tracking systems may be required to assess variable free face burdens

- (d) Approved and calibrated monitoring devices, such as temperature probes for hot holes, gas monitoring systems where noxious gases are expected on the bench or after the blast, and vibration/overpressure monitors;
- (e) Non-explosive blasthole accessories such as gas bags, blasthole savers, stem plugs, collar pegs and initiating explosives retention devices;
- (f) Approved cutting devices for detonating cord and explosives packaging;
- (g) Approved circuit testing devices and firing systems/devices for electric, electronic and signal tube firing systems;
- (h) Video recording devices.

3.2 Required Competencies and Training

Any person involved in blasting activities must have completed, or be undergoing, the following company and/or site training where relevant: -

- a) Induction program for all employees (generic and site-based, as applicable), and site familiarisation tour;
- b) Appropriate vehicle competencies and authorisation in relation to the vehicles being utilised on site and within a blast area;
- c) Appropriate training package for working with explosives, or otherwise working in close proximity to explosives or within a blast area;



- d) Appropriate training package(s) for using the specific explosive systems deployed at the site, such as electric or signal tube delay detonators, detonating cord, electronic initiation systems, presplit products etc.
- e) Appropriate competency and authorisation of employees (including licensing and security clearance) as required for operating specialized equipment (e.g. MPU, dewatering or stemming equipment) or conducting specialized activities (e.g. Shotfirer, Assistant Shotfirer, Magazine Keeper, Blast Controller, Blast Guard). **Note:** Appropriate licensing/security clearances are required for persons having unsupervised access to security sensitive products such as explosives and precursors e.g. AN, ANEs, detonators, etc.;
- f) Site specific personal protective equipment (PPE) requirements and special / task specific requirements, including training in the proper use and care of applicable equipment;
- g) Demonstrated competence in relation to agreed radio protocols.
- h) Emergency response and evacuation procedures.

Each site, under an appropriate safety/security management plan, must maintain a record of personnel who are deemed competent and available to perform relevant roles, and who are authorised to access explosives and precursors. These may include shotfirers, blast controllers, magazine keepers, blast guards, explosives handlers and explosives equipment operators.

Sites must maintain a regular review and renewal of training and competency requirements as required by legislative or company requirements.

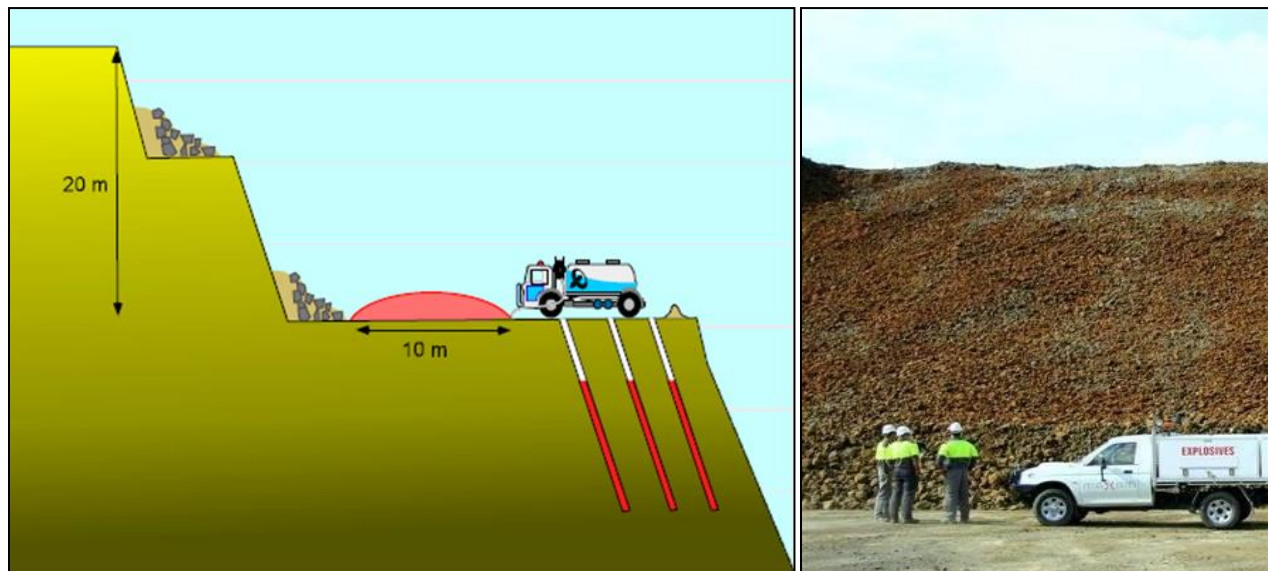
4.0 RISK ASSESSMENT

Risk assessments at a broad operational level, and more specifically focusing on the management of blasting and explosives, provide guidance for dealing with the hazards and potential consequences of undesired outcomes and impacts. Controls to manage the identified hazards/risks should consider the hierarchy of controls so that the most effective measures are employed. These exercises must be conducted by a representative group of stakeholders, including management, technical and operational personnel.

Specific risk assessments must also be carried out, identifying the hazards that could be presented by an individual shot, and the controls required at each stage of the blasting process. Operational risk assessments should also be conducted on a daily or shift change basis as relevant. Again, these exercises must be conducted by a representative group of stakeholders.

The main areas to consider include:

- (a) 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.;
- (b) Bench preparation and demarcation – Identifying the hazards and controls associated with equipment and personnel working within the blast area, including broken ground, cavities, vehicle rollover, unsafe high-walls/low-walls, adverse slope and crest conditions, unauthorised access, water management and interaction with other mining processes;



Consider danger zones within half the height of the face, measured from the toe of any rill



Interaction of MPU's with active haul routes must be risk assessed

(c) Priming, charging and stemming blastholes – Avoiding hazards associated with the snap/slap/shoot of signal tube downlines, unplanned detonation in elevated temperature and/or reactive ground, and flyrock/overpressure associated with overloaded or under-burdened holes;

(d) Blast clearance & shotfiring – Ensuring adequate blast clearance and controls are in place to prevent unauthorised access into the blast exclusion zone while blasting is in progress and until after the 'all clear' has been given. Identifying where post-blast inspection of any critical areas is required, such as unstable wall conditions and misfires, and where physical barriers need to be established after the blast.

In some cases, additional risk assessments will be required for specific high risk processes, such as blasting in elevated temperature and/or reactive ground areas, blasting in areas with a known history of generating post-blast fume, working in areas with cracked and/or unstable ground conditions, working under steep walls or slopes, or working in areas with noxious gases such as carbon monoxide and nitrogen oxides, either on the bench or during re-entry after the blast. Consideration should also be given to any old underground workings in the vicinity.

While the above risk assessment stages are not all directly associated with on-bench blasting activities, the various hazards and controls must be understood by personnel working on-bench to ensure that potential consequences are understood for the complete process.

Operational or specific risk assessments of on-bench activities are best carried out at the work area, prior to the commencement of work (e.g. SLAM, Take5, JSA, etc.). When a formal risk assessment is carried out it must be approved in accordance with the relevant safety management systems and accepted and signed by all of the relevant parties involved in that blasting process prior to work being undertaken.

4.1 Factors to consider in assessing risk

Factors to be taken into account during the risk assessment include (but are not limited to) the following:

- (a) The location of protected works and/or associated works, and any external infrastructure potentially affected by the blasting activities (air, road, rail, power, pipelines, underground workings etc.);
- (b) The type of shot (cast blast, stand-up shot, presplit, boxcut, thin parting/seam, etc.);
- (c) Aim of the shot (required fragmentation, heave profile, vibration outcomes etc.), taking into account the mining/quarrying method, excavation equipment to be used, direction of fire and initiating point;
- (d) Known geological variation within the blast design area. This includes the presence of hard/soft bands or zones, faults, joints & bedding planes, dykes & sills etc.;
- (e) 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;
- (f) Access to/from the blast area, and within the blast area, and the ability to charge and sequence all blastholes to design specifications. This may include consideration of an on-bench Traffic Management Plan to ensure that charging, dewatering and stemming equipment can access all blastholes safely, without the need to drive over blastholes or straddle charged holes. The Traffic Management Plan should include a designated park up area to minimize vehicle interaction. This minimises the risk of impact or damage to initiating systems from vehicle traffic and stemming operations, and the potential for misfires or unplanned detonation;
- (g) Access to and from the proposed Blast Exclusion Zone. An exclusion zone should be identified prior to the commencement of charging and maintained at all times, in the event that evacuation is required due to approaching electrical storm, bushfire or some other emergency response. Mining processes adjacent to the blast area should not hinder this access;
- (h) Interaction with other mining processes adjacent to the blast area, such as drilling and excavation, and safety hazards associated with steep slopes, noise and dust;
- (i) Slip, trip, fall and manual handling hazards within the blast area, associated with uneven or muddy ground, or poor weather conditions;
- (j) The intended application and combination of specific bulk explosives, boosters, and initiating systems must be consistent with supplier guidelines. For example, suitability for use in elevated temperature conditions, or compatibility of initiating explosives such as detonating cord and boosters;
- (k) All explosives, blasthole accessories, equipment and tools must be approved by management for use on site, with appropriate technical data sheets and safety data sheets provided by the supplier;
- (l) Specific risks associated with particular explosive products such as electric detonators and electrical/RF hazards; safety fuse and burning speed variability; and the potential for stretch- snap-slap-shoot events when using signal tube systems;



- (m) Previous history of flyrock, poor fragmentation, inadequate/excessive blast movement, and/or excessive blast damage;
- (n) Previous history of excessive vibration, overpressure and dust, or complaints of disturbance from nearby community members;
- (o) The previous history of, and potential for, generation of post-blast fume (NO_x) and associated blast size and sleep time restrictions, firing time limitations, or meteorological constraints;
- (p) The forecast weather conditions (particularly rainfall, lightning, dust storm, wind, and fog which may reduce visibility);
- (q) The location of equipment and personnel at the time of firing and any radio communication black-spots;
- (r) Daily planning/scheduling requirements and time available to complete necessary tasks;
- (s) Where required, blast design, measuring and monitoring devices (face profiling, blasthole tracking, temperature probes, gas monitoring systems, vibration/overpressure monitors, video equipment, etc.) should be available and calibrated;
- (t) Documented blast design parameters, including blasthole diameters, burden and spacing; bench height range; relative elevation of the bench; range of charge mass per hole or per deck; designed blast powder factor; timing, including the required inter-hole, inter-row, and downhole delays, and firing direction, and stemming parameters;
- (u) Additional controls and QA/QC records for any blasts deemed unusual or 'high risk'. This may include secondary blasting considerations, firing multiple shots as a single event, or firing blasts in close proximity to each other (measured horizontally or between different levels).

Once work in a blast area has commenced, all personnel must continually assess conditions and report hazards to the relevant supervisor of the work area. The site change management process must be well understood by all personnel and work should not continue if it is not safe to do so.

All incidents and accidents must be reported through the relevant safety management systems for the site.

5.0 BLAST PLANNING AND RECORD KEEPING

5.1 Blast Planning

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

Factors to be considered include:

- (a) The blast area is to be defined, designed and scheduled so that drilling, charging and firing requirements can be quantified and scheduled in advance;
- (b) 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;
- (c) The blast area must be available for blasting operations to proceed, without unsafe interaction from other mining activities such as excavation and haulage. Consideration should be given to the effective use of physical barriers such as safety berms;
- (d) Bench preparation is to be completed on time, to an adequate standard for safe and efficient drilling and charging;
- (e) Drilling operations are to be progressed at a rate that will allow on-bench blasting operations to commence and be completed on time, without excessive sleep time as a result of drilling delays;
- (f) Interaction between drilling equipment and blast crews is best minimised to prevent unnecessary additional risk. If working near a drill is required it should be done under an appropriate risk assessment with consideration of all relevant issues, including, but not limited to:
 - increased noise and dust levels;
 - potential for fluid injection injury if there is a hydraulic line burst;
 - clearance separation from the front deck of 2x drill rod lengths in case the drill rod dislodges from the carrousel;
 - access to the drill rig for servicing and in an emergency; and
 - a delineated exit path for the drill at the completion of drilling.

A demarcated minimum stand-off distance, equivalent to at least two rows or 15 metres, whichever is the greater, from the nearest hole or MPU must be maintained. Where this cannot be avoided (for example re-drills), such operations must be carried out under supervision and specific risk assessment;

(g) Sufficient explosives products and blasthole accessories are to be available (or have been ordered) to allow on-bench blasting operations to commence on time and be completed. In particular, bulk explosive blends to suit likely ground conditions (dry, damp, wet), a sufficient number of initiating products (of appropriate length and delay), gas bags to suit blasthole diameter, sufficient suitable stemming material etc.;

(h) 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;

- (i) The shot must be completed and then fired within an acceptable timeframe (sleep time), allowing for explosives limitations, weather conditions/delays, weekends, and interaction with other processes. Limiting sleep time can be dependent upon ground conditions (elevated temperature, dynamic water etc.), or the sleep time parameters of either the bulk explosives (e.g. dry/damp/wet conditions) or the initiating explosives (e.g. diesel ingress into signal tube).
- (j) The sleeping of blasts outside normal operating hours must take into consideration requirements for maintaining restricted access and explosives security, with appropriate demarcation, guarding and supervision, to also be effective during any night shifts.

5.2 Record Keeping

All relevant information regarding the blast must be maintained as part of the blast management system, with appropriate approval and responsibility recorded throughout the process. A copy of this information must also be available for each blast, in a 'blast pack' for use by the shotfirers. This is likely to include:

- (a) Blast summary sheet showing nominal blast pattern, total drill metres, estimated bulk explosives requirements and design powder factor, stemming requirements, and quantities/types of initiating explosives and blasthole accessories;



All relevant information regarding the blast should be maintained as part of the blast management system

- (b) Plans and specifications detailing blast location, blast boundary and bench preparation requirements;
- (c) Risk assessments for the blast work area at various stages in the blasting process with a record of all persons entering the blast loading area to be maintained. This is to ensure that all persons within the

blast loading area have reviewed the risk assessment and are aware of the identified hazards and the controls, and can be interviewed in the event of an incident;

(d) Drill pattern showing blasthole layout, with blasthole ID, location, depth, angle, direction, and diameter of all blastholes. Cross-sections are desirable where varying depths (e.g. stab holes) and different angles (e.g. face holes) apply across the shot. A table of this information may also be available in the form of drill sheets, so that actual drilled records can be compared to design;

(e) Charge sheets detailing the location of primers, charge mass and length, length of inert decks (gravel, air or water), and stem heights for each blasthole. Cross-sections are desirable where multiple decks are used, to show the required deck and primer location. Product selection requirements should be specified where dictated

by ground conditions (e.g. depth of water, hard/soft areas, face holes etc.). Actual dipped depths and charged quantities are also to be recorded, and compared with design quantities on a hole-by-hole basis (variations to be recorded);

(f) Additional records may be required to define specific blasting conditions, such as temperature logs for blasting at elevated temperature; identified voids when blasting over underground workings; blocked blastholes in cracked ground; the location of slumped holes after a rain event; the location of known or potential misfires where lost downlines cannot be recovered;

(g) Tie-up plan showing the initiation hole, initiation sequence and firing direction, and connection sequence (for electronic systems). Guidelines to deal with additional or missing holes are also recommended. Modifications to the design tie-up should be recorded on the plan, particularly where changes have been made to accommodate additional or missing holes;

(h) Blast clearance plan(s) showing the name/identity of the blast, location of the blast with respect to roadways and other mining activities, blast notification requirements, blast guard positions, the extent of the blast exclusion zone for personnel and equipment, the Shotfirer's firing position, and the location of sensitive locations/infrastructure. This information is required at the start of charging activities, in the event of an emergency situation such as an electrical storm or fire on an explosives vehicle, when rapid clearance of the blast area may be required, or in the event that emergency firing is required (expected flooding, identification of hot ground etc.);

(i) Magazine records, showing explosive quantities taken from the magazines, used on the shot and returned to the magazine. This must be recorded in a way that allows appropriate reconciliation of initiating explosives for specific product types, in order to identify unexplained losses or theft, and to ensure explosives storage limits are not exceeded;

(j) Bulk explosives delivery records by truck and shift, that allow reconciliation of actual and design densities and quantities, of explosive products used;

(l) Bulk explosives delivery records that allow identification of which holes were loaded by which truck;

(m) Manifests carried on any vehicles carrying initiating explosives, enabling reconciliation of explosives stock;



(n) Shotfirer's daily/shift/roster report, including blast summary information, firing time/date, weather conditions at the time of firing, and blast performance comments regarding fragmentation, heave profile, flyrock, fume, misfires etc. Separate reports may need to be completed regarding misfires and environmental impacts;

(o) A video record of the blast event, and pre/post blast photographs provide an essential visual record, particularly in the event of an unexpected blast outcome or impact.

All site records should be completed and maintained for an appropriate length of time consistent with relevant management systems.

6.0 BENCH PREPARATION AND DEMARCATION

Bench preparation is critical in establishing a safe working environment for all activities associated with blasting. Standards for bench preparation must meet the requirements of subsequent on-bench activity, in terms of the preparation and demarcation of those areas.

6.1 Bench Preparation

Factors to consider may include:

- (a) An inadequately prepared blast area can significantly impact the blasting process, with blastholes not correctly drilled or charged due to poor accessibility, and subsequent poor blasting outcomes including oversize, flyrock, fume, misfires etc.;
- (b) Bench preparation carried out prior to drilling may need to be repeated after drilling, particularly the clean-up between rows for access by personnel and equipment.
- (c) Inadequate demarcation and security measures can result in additional safety and security risks, particularly unplanned detonation risks associated with vehicle movements in the vicinity of initiating explosives, and the unexplained loss or theft of explosives;
- (d) Adequate bench preparation is required to suit all equipment operating on the blast bench, including drills, MPU's, stemming equipment, light vehicles, refueling vehicles, water carts, etc. This also applies where large bulk transport vehicles are delivering explosives precursors (AN, ANE) to reload areas;
- (e) Grades and cross-grades for access routes and the blast bench must be within the operating range for the most constrained (least flexible) equipment in use;
- (f) Adequate turn-around room, or drive-through access, for vehicle traffic on/through the blast area, such that vehicles do not need to tram over blastholes.
- (g) Appropriate clearances from high-wall and crest hazards is required for the safety of the blast crew. A minimum stand-off distance is required from all high-walls or lowwalls. Most sites will use a minimum 10m stand-off dependent on the outcome of a risk assessment. The risk assessment should consider all relevant issues, including, but not limited to:
 - type of high-wall i.e. pre-split or buffer wall;
 - the angle/slope along the length of the wall;
 - size of the material on the face of the wall;
 - visible signs of material rolling off the wall or movement of the wall;
 - whether catch berms are in place at the toe of the wall and their condition;
 - whether catch benches are in place and their condition;
 - constant slope and angle of the wall; and
 - possible impact of changing weather conditions on the wall.

The high-wall clearance zone should be delineated with a catchment berm to provide an identified barrier for the blast crew.

If walls show evidence of movement, slabbing or section failure a detailed geotechnical review should be conducted.

At sites where the blast crew are not in regular attendance or not familiar with the high-walls or lowwalls (e.g. quarry sites with campaign loading) a risk assessment must be conducted, or half the height of the wall must be used as the stand-off distance.

A crest berm or windrow should be constructed equivalent to half the height of the largest vehicle wheel working on the bench. If a continuous crest berm or windrow is not achievable, or if cracking or crest damage extends past the foot of the berm, the crest must be clearly demarcated by a paint line, flutter tape, cones or other identifiable means at least two metres from the crest edge;

(h) The width and stability of narrow terraces within the blast area must be sufficient for all equipment likely to access those terraces;

(i) Bench surfaces to be adequately prepared to provide a safe work area for the shot crew without unnecessary trip/fall hazards or climbing required. This must be done in a manner that does not push material into drilled blastholes;

(j) Bench surface to be prepared with consideration for natural drainage in the event of rainfall, to avoid accumulation of water on the shot and/or the creation of boggy ground conditions. Additional drainage may need to be established to remove accumulated water from the blast area, or prevent accumulation after charging has commenced.

(k) Designated vehicle parking areas and tipping areas for stemming material. Access to the blast area is best restricted to essential vehicles, with non-essential vehicles parked safely outside the perimeter where possible. Stockpile areas for stemming material are also best maintained outside the blast area, with suitable access and stable ground for trucks to dump loads of stemming. Where stemming is dumped within the blast area, for manual stemming or placement by loading equipment, it should be placed prior to the commencement of priming and charging, with care to avoid driving over or covering drilled holes.

Following the bench preparation process, the bench standard should be formally accepted, in writing, by those conducting activities on the bench associated with blasting.

6.2 Demarcation and Communication of Active Blast Areas

Physical demarcation and signage must be established to minimize the risk of inadvertent access to the blast area (or on-bench reload area) by unauthorised personnel/equipment, or access to unsafe crests or under unsafe wall conditions by personnel/equipment on the shot. Safe exclusion distances from all crests and walls should also be observed (refer to 6.1 above).

Demarcation can include a combination of physical barriers (safety berms), traffic cones, bunting, flashing lights etc. Signage should indicate an active blast area and must also indicate the status of that area (e.g. loaded shot, tied-up shot). This should include the area on the bench below the shot to prevent personnel and/or equipment moving too close to the face.

Demarcation and signage also defines the secure blast area within which explosives security restrictions apply and unsupervised personnel are required to hold security clearance and site authorisation. Unauthorized persons must obtain permission from the Shotfirer (or other authorised person) prior to entering the blast area (or reload area). A guard should be positioned to prevent unauthorised access if other supervision, inspection and security measures are not deemed adequate.



Typical examples of Clear signage to indicate a blast area and blast exclusion zone is an essential part of the demarcation process



If 'hard' barriers cannot be established between a blast area and other activities, then appropriate clearances are necessary and clear demarcation and signage essential to warn against unauthorised access

Communication of active blast areas (where charging has commenced) can be facilitated via suitable blast boards and at pre-shift meetings, so all personnel are aware of blasting locations, clearance areas and the route(s) being used to transport explosives to/from those locations.

A traffic management plan should be used to define entry/exit points for vehicles, park-up areas, reload areas, and the required loading sequence.

7.0 MEASURING AND PRIMING BLASTHOLES

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.

7.1 General

The following activities and/or considerations will help to ensure safe and efficient on-bench activities associated with measuring and priming of blastholes:

- (a) Ensure that the blast area is suitable for charging activities, and that charging activities will not be compromised by other activities, such as bench preparation, drilling, excavation or vehicle movements in an adjacent area;
- (b) A clear blasthole identification system (such as row and blasthole number) must be in place to allow the correct treatment of all blastholes. This can be done by marking blasthole ID's on a peg or other marker at the collar;
- (c) Ensure that blastholes have been drilled to design (diameter, spacing, burden, location, depth, angle, and orientation) prior to charging, by reference to the blast pack showing the required layout and any available drill logs. If this is unclear discuss with the supervisor, drill operator and/or engineer to clarify;
- (d) Variances in blast parameters require further assessment prior to charging, or remedial action such as re-drilling, backfilling or adjustments to the blast design such as charge quantity or initiation sequence. Acceptable variances must be communicated clearly to the Shotfirer, as such variances may be more critical in some cases (for example stem height variation when blasting near infrastructure, or explosives selection in fume-prone areas);
- (e) Where re-drills are required adjacent to (or within) the blast pattern, priming and charging of blastholes must be managed to prevent drilling in close proximity to explosives, with minimum acceptable drilling clearances from any charged blasthole. This must take into account the separation of angled and/or deviated holes at depth, and equipment capability. Re-drilling within, or adjacent to, a loaded shot and loading operations must take place under supervision of the Shotfirer, with clearly defined exclusion zones in accordance with applicable legislation and approved site practices. The relocation route of the drill and ancillary equipment (fuel and water trucks) through the blast area must be clearly defined and managed to avoid damage to other blastholes;
- (f) Clear blocked holes where possible to allow the placement of correct charge quantities. Where blastholes cannot be charged, or changes to priming requirements and/or charge quantities are identified outside the expected range for the blast area, this must be communicated to the supervisor for authorisation, and recorded;
- (g) Where blastholes have been drilled too deep they are to be back-filled with suitable stemming material (or drill cuttings in dry conditions) to achieve the required depth;
- (h) Where blastholes have been redrilled, then previous 'abandoned' blastholes are to be identified and filled with suitable stemming material. Alternatively, 'abandoned' blastholes can be sealed with a gas bag and stemmed to prevent ejection when adjacent holes are fired. However, the creation of a cavity in

close proximity to a charged blasthole should be assessed as it is likely to affect localised blast performance and may also result in additional fume;



Where blastholes have been redrilled, then previous 'abandoned' blastholes should be identified. They should not be left open as this increases the risk of venting when adjacent holes are fired

- (i) When blastholes have been sealed at the collar with a gas bag then caution must be used when removing these devices to avoid ejection of material towards the operator's face;
- (j) Where elevated temperature and/or reactive ground is expected or encountered, specific blasting procedures, explosives and controls will be required (see the relevant AEISG Code and site procedures);
- (k) Where blastholes are to be dewatered this must be carried out prior to the placement of any explosives in the blasthole, and in a sequence that avoids run-off into dry or previously dewatered blastholes and avoids the creation of boggy conditions for operating equipment. A sufficient delay between de-watering and charging the blasthole is necessary to determine if 'dynamic' water is present, as this will influence the product type loaded and the sleep time available.



When using dewatering equipment consider the impact of run-off on the work area and other blastholes

7.2 Measurement

All blastholes must be measured prior to charging, in the event that re-drills or adjusted charging is required. If measurement was carried out prior to the day of charging, and a physical change to the blasthole is likely (e.g. following a rain event), then it is recommended that blastholes be re-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. Check that the tape has not been damaged and starts at the 'zero' mark.

Depths are to be measured from the bottom of the blasthole to the collar at the bench surface, disregarding the height of the drill cuttings, and recorded on a blasthole-by-blasthole basis.

In addition to the depth of the blasthole, it is also advisable to record the depth of water in the hole and the extent of wet/damp sidewalls on the blasthole dipping sheet. Also note any evidence of collapse of the blasthole. This assists with appropriate bulk explosive selection, and provides guidance in the event that post-blast fume is generated.

An assessment is to be made in the event of broken ground at the collar, reduced free-face burdens, excessive toe burdens, or reduced stand-off from broken ground, as to whether adjusted stem heights, primer locations and charge quantities are required.



An assessment should be made whether blocked holes, with broken ground at the collar, are suitable to load

Where the variation in front row burdens is critical, due to flyrock or overpressure risk, measurement of face geometry and blasthole deviation may be required with laser profiling and borehole tracking systems. Adjusted charge quantities, gravel decking and increased stem heights may then be required.

Where elevated temperature blasthole conditions are experienced or anticipated, temperature measurement will also be required (refer **AEISG Code of Practice, “Elevated Temperature and Reactive Ground”**). Specific explosives products and blast management protocols then apply.

Where specific strata or ground conditions need to be identified (e.g. through-seam blasting, or blasting near underground workings), the use of geophysical logging equipment or borehole camera equipment may be required to identify the location of target horizons or structures. More accurate placement of explosive charges and aggregate decks will then be required.

7.3 Priming

Priming considerations should include the following:

- (a) 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. Further, they need to be used in accordance with the manufacturer's/supplier's recommendations;
- (b) A record of initiating explosives taken from the magazine, used, and returned to the magazine, must be maintained as required under the Site Security Plan. Boosters and detonators must be kept separate until assembly as primers immediately prior to placement in the blasthole;

(c) The required number of boosters and downlines should be available for the shift, and laid out at the blasthole collars as required, with a peg (or other suitable retention device) to secure the downline at the collar;

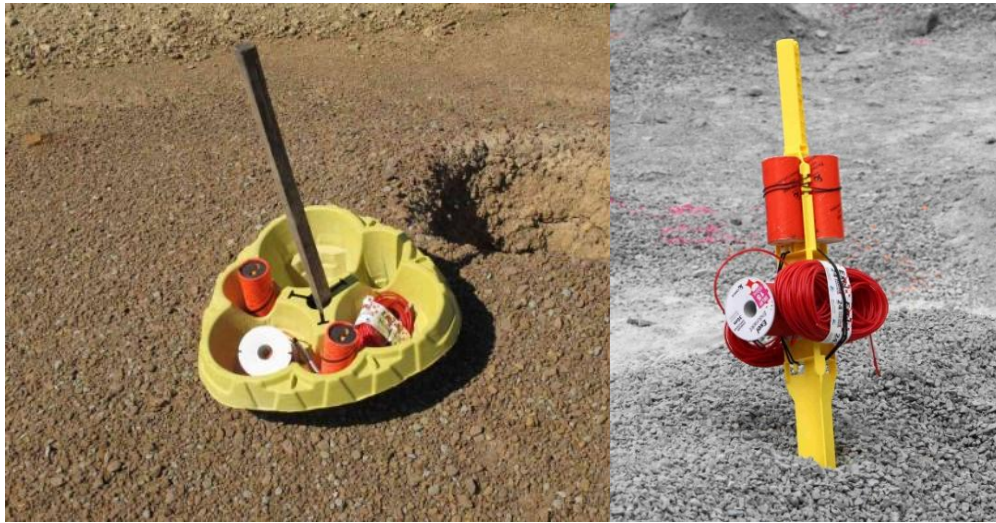


Downlines should be secured at the blasthole collar

(d) Place initiating explosives on the same side of each blasthole in the row or echelon, on the opposite side from that being used by charging and stemming equipment (depending on traffic management guidelines for the blast area);

(e) Carry out priming (and subsequent charging) in an identified sequence to facilitate the tracking of explosives usage, and minimise the risk of damage/impact to initiating explosives from vehicles in the blast area;

(f) The use of initiating explosives retention devices at blasthole collars should be considered for the housekeeping of initiating explosives, as there is a potential for detonators and boosters to be misplaced within the drill cuttings or in soft/muddy ground or fall into the blasthole during or after placement. Further, such identification and retention minimises the potential for interaction with vehicles in the area.



The use of initiating explosives retention devices at blasthole collars should be considered where there is a potential for detonators and boosters to be misplaced and/or impacted by vehicles

(g) Do not throw or mistreat initiating explosives. When making up primers, a detonator must not be forced into the booster. When cutting detonating cord, approved cutters must be used. Primers should be lowered carefully into the blasthole, not allowed to free fall to the bottom of the hole;



When making up primers with boosters, a detonator must be fully inserted, but not forced, into the booster

- (h) Primers are to be positioned as per decking guidelines (i.e. primed at the top, middle or bottom of the deck), subject to blasthole depth and blasthole condition. Primers are typically placed every 10 to 15 metres;
- (i) In dry (or damp sided) holes the bottom primer is normally positioned 1 to 2 metres off the bottom of the blasthole where it will sit within the bulk explosive when loaded;
- (j) If the bulk explosive will not easily flow past the top primer(s) positioned in small diameter dry holes, then these can be positioned during the loading process;
- (k) In water-filled blastholes the primer(s) is normally lowered to the bottom of the blasthole at the start of pumping and pulled up into the explosive column as it is charged. A member of the blast crew must monitor the primer when charging wet blastholes, to ensure floating of the primer on top of the explosive column is prevented;



Make sure that primers do not 'float' when delivering pumped explosives

- (l) Additional primers may also be required in broken ground or areas likely to generate significant post-blast NO_x fumes. Such primers should be timed to initiate simultaneously within the explosives column to eliminate the potential for column disruption, resulting in misfires;
- (m) Once primed, downlines must be secured at the blasthole collar, usually on the same side of the blasthole. Loose tails must also be secured at the collar preferably on the side away from the charging vehicle, where they cannot be driven over or caught by passing traffic;
- (n) Primers should not be left unsupervised overnight in uncharged blastholes where they present a security risk. Where direct supervision cannot be satisfactorily addressed, primers must be removed from the blasthole, disassembled, and returned to the magazine;



(o) Collect all waste packaging, and dispose of according to site waste management practices. Check that such packaging is empty of all explosive products and 'Explosives' markings removed/covered prior to disposal;

(p) The recording and reconciliation of initiating explosive quantities must be carried out against the quantities specified in the blast design, and the quantities issued from and returned to the magazine to identify correct usage and unexplained losses. Unexplained losses must be reported in accordance with site and regulatory requirements.

8.0 CHARGING AND STEMMING BLASTHOLES

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.

8.1 Bulk Explosives Selection and Delivery

The following factors are relevant:

- (a) Bulk explosives must be charged under the supervision of the Shotfirer, to design charge mass and column rise as per design guidelines (charge sheets) and to suit the ground conditions encountered;
- (b) Blasthole conditions (rock type, depth, wet holes, wet/damp walled conditions, and likely sleep time) will determine bulk explosives selection. Blast designs must clearly indicate the conditions under which specific bulk explosives can (or cannot) be used. Suitable blasthole identification and records must be maintained to ensure correct charging;
- (c) Bulk explosives must be selected with appropriate properties for the intended application, including water resistance, minimum diameter, critical density, and depth limitation, and suitable explosive performance for the ground type and pattern size being used;
- (d) Dry hole explosives (ANFO and heavy ANFO blends) can be augured into dry blastholes, or dry-sided blastholes where contact with water at the toe has been effectively sealed with a gas bag and drill cuttings;
- (e) Heavy ANFO blends that are suitable for damp-walled conditions can be augured into blastholes that have been dewatered, or where contact with water at the toe has been effectively sealed with a gas bag and drill cuttings, assuming that significant recharge is not taking place. These blends must not be augured into water as it will cause product deterioration at the toe around the primer. The presence of dynamic (flowing) water prevents effective dewatering and blastholes in these conditions are not suitable for augured explosives;
- (f) Pumped emulsion blends suitable for wet conditions can be pumped into blastholes containing water, as long as the hose is lowered to the bottom of the hole and retracted slowly during the pumping process in order to effectively displace water from the hole, rather than entrap it within the explosives column. These blends must not be pumped into a wet blasthole from the collar, as this will seriously degrade the product. The presence of dynamic (flowing) water requires a bulk explosive with good water resistance and ongoing monitoring to ensure that the column is not being washed away. Dynamic water can degrade a column of pumped emulsion, even if loaded correctly;
- (g) 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. The treatment of blastholes as dry, damp or wet should also take into consideration the condition of surrounding blastholes, and whether significant rainfall runoff and water accumulation in low areas is anticipated.

(h) When charging decked holes (particularly in pre-split or through-seam applications) additional care is required in terms of primer location, column rise, positioning of gas bags and stemming material.

8.2 Managing Vehicles in the Blast Area

The charging process is to be managed in a manner that allows the efficient and safe use of charging and stemming equipment, bearing in mind the interaction required between members of the shot crew working in close proximity to large mobile equipment.

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. Consistent radio communication and/or hand signals must be understood by all personnel (Refer to the site Traffic Management Plan).



Ensure safe management of vehicles within the blast area and good communication with personnel on the ground

Where necessary, a spotter shall be used to assist the operator of mobile equipment maneuver close to walls and crests, in close proximity to blastholes on tight patterns, when reversing or turning around on the bench, or in any situation where restricted visibility presents a risk.

All attempts should be made to prevent driving over blasthole collars, regardless of whether they are empty, primed or charged. If this is unavoidable then empty blastholes should be sealed with a gas bag to prevent backfilling, and primed holes must have their primers removed and be similarly sealed. Under exceptional circumstances it may be necessary to traverse a charged blasthole. In this case, a risk assessment must first be conducted, and where deemed acceptable, visible downlines must be buried within the stemming zone and a spotter used to direct the vehicle such that it can safely straddle those blastholes and not drive over the collars.



Bad Practice -Do not plan to drive over blasthole collars, regardless of whether they are empty, primed or charged



Where restricted visibility presents a risk, a spotter shall be used to assist the operator in maneuvering.

Blastholes are to be charged systematically, in sections on large shots, allowing completion of a reduced blast area if unfavourable conditions (such as wet weather) are likely to prevent firing within the required timeframe.

Where blastholes cannot be safely charged or stemmed using explosives trucks or stemming vehicles, such holes may need to be charged and stemmed by hand.

Charging during hours of darkness requires additional controls and safety measures that include specific risk assessment, appropriate lighting, not working directly under or above any walls (refer to Section 6.1), reduced vehicle access into the blast area, and additional demarcation (e.g. flashing lights).

8.3 Charged Quantities

During charging operations, consideration should be given to the following:

(a) Check column rise during charging using a bobbing tape or dip stick, to ensure that blastholes are not over (or under) loaded outside acceptable tolerances for the blast. Delivered charge mass and measured deck length will usually be close to expected values, based on bulk explosive density and the nominal blasthole diameter, otherwise additional checks will need to be made;



Check column rise during charging using a bobbing tape or dip stick, to ensure that blastholes are not over or under loaded outside accepted tolerances

(b) Bulk explosive cup or bucket densities must be routinely checked for each load, particularly where chemical gassing is employed. Variances outside expected ranges may be indicative of incorrect blend ratio, or inadequate/excessive gassing, and may be related to AN/ANE quality or truck calibration problems. Unexpected bulk explosives variance must be recorded and reported to the Shotfirer;

(c) Bulk explosive density and charge mass may need to be increased where excessive toe burdens are identified at the face, or adjacent to short holes, to achieve a higher localised powder factor. This should only be done following consultation with the Shotfirer;

(d) Bulk explosive quantities may need to be reduced (or removed) from free-face blastholes with inadequate burden to contain explosive energy, or in areas of broken ground;

- (e) Where blastholes have been under-charged, additional top-up amounts may be acceptable within design charging and stem height guidelines. Stem heights should not be reduced to accommodate design charges;
- (f) Where blastholes have been overcharged, excess product may need to be removed. Following a satisfactory risk assessment, an approved scoop or vacuum equipment appropriate for the task may be used to remove bulk explosives and stemming in order to achieve correct column rise or height. Care must be taken to ensure metal parts are removed from hoses and to secure downlines. This process must be carried out under supervision of the Shotfirer. Alternatively, excess bulk explosives can be purged (displaced) from the blasthole using water pumped from the explosives truck or a water cart;
- (h) If bulk explosives appear to be running away in broken ground (e.g. a lack of column rise) charging must be halted and the situation assessed on a case-by-case basis. The subsequent behavior of that charge (when detonated) will be uncertain, with a potential for excessive flyrock, overpressure or fume. The safest practice is to attempt to remove the primer (if possible) then stem and abandon the hole. Alternatively, charging should be halted, the Shotfirer contacted and an appropriate process determined e.g. a risk assessment is carried out and an increased blast exclusion zone considered;
- (i) Care must be taken not to lose downlines in the blasthole during the charging and stemming process. Preferably, downlines are to be hand-held during charging/stemming or, if this is not possible, secured at the collar. If lost downlines cannot be retrieved, then the blasthole must be reprimed prior to further charging; (with accounting for any additional explosives required);
- (j) If bulk explosives have slumped after charging and the downlines lost and unrecoverable, the blasthole will need to be re-primed with additional charging in an attempt to minimise the risk of misfires. Such holes represent additional misfire risk and must be recorded and checked after firing; (with accounting for any additional explosives required);
- (k) The location of overloaded blastholes must be communicated to the Shotfirer while charging is still taking place in the blast area. If this cannot be rectified then increased blast clearance distances may need to be applied;
- (l) When using packaged explosives in small diameter and pre-split applications, follow supplier guidelines regarding priming practices, placement and securing at the collar. Additional care needs to be taken to ensure that packaged product is reliably positioned along the length of the blasthole, suitably primed and securely fastened to avoid loss down the hole;
- (m) Recording and reconciliation of the quantities of explosives (and raw materials) delivered according to the delivery docket, should be carried out against the quantities specified in the blast design, and those loaded on a hole-by-hole basis during charging. This provides a check against average density and the ratio of AN, ANE and diesel in blended explosives.

8.4 Stemming

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.

Stemming must not commence in blastholes containing gassed explosives until such explosives have had sufficient time to reach their design density, and a check has been made that design column rise has been achieved, and meets the requirements of the shot 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.

During the placement of stemming, either by mechanical or manual methods, downlines need to be secured to prevent loss down the blasthole, and to ensure that they are not damaged. Stemming should be delivered at a rate that minimises the risk of bridging of the

stemming column. Ideally, a spotter should be available to assist and protect downlines during the stemming process.

Stem heights may need to be increased where broken ground is evident at the collar, or where reduced face burdens are identified for the blasthole profile. Aggregate decks may be required where reduced burdens are identified lower in the blasthole profile. Actual stem heights and aggregate deck lengths should be recorded.

In wet holes, additional time needs to be provided to enable stemming to seat effectively.

Downlines can be loosened after stemming to reduce the risk of stretching or snapping due to possible slumping. Blastholes that have slumped after stemming must be recorded and reported to the Shotfirer. These holes shall be monitored, have their downlines loosened where necessary and re-secured and the stemming topped up as appropriate.

Note: Precautions need to be taken to prevent interaction between the downlines and personnel/traffic.

Uncharged blastholes must be backfilled, to prevent excessive venting/cratering when adjacent blastholes are fired.



Provide adequate slack to allow for settlement in the blasthole. Blastholes that have slumped after stemming should be recorded and reported to the Shotfirer

9.0 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, misfires and poor fragmentation.

9.1 General

Careful consideration should be given to the following:

- (a) All non-essential vehicles must be removed from the blast area (or from the immediate vicinity of blastholes being connected), prior to the placement and connection of surface delays under the supervision of the Shotfirer. Tying up should not commence in an area through which vehicle traffic is still required;
- (b) The required number of surface delays (of the correct delay and length) should be available for the blast, and laid out at the blasthole collars as required. Surface delays should be placed on the same side of each blasthole in line with the row, to assist in their visibility. Initiating explosives must not be thrown or otherwise mistreated;
- (c) Blastholes should be tied up as indicated on the tie-up plan (or instructions) provided in the blast pack;
- (d) Slumped holes must be topped up with stemming or drill cuttings immediately prior to tie-up where possible and recorded;
- (e) Where weather conditions prevent the firing of a tied-up shot during the shift, the shot will be untied in the first instance, however if that shot is to remain tied up overnight additional controls will be required. These include disconnection of the control row, and any holes beneath a wall; supervision of the tied-up shot unless site security is deemed adequate without this; additional signage (e.g. shot tied-up) and demarcation such as flashing lights. Shots must not, however, be tied up during hours of darkness, or if it is not planned to fire the shot until the following day;
- (f) On completion of surface tie-up, all unused explosives are to be returned to the magazine, and empty boxes checked prior to disposal. 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;
- (g) 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.

9.2 Signal Tube Systems

When employing signal tube detonator initiating systems the following factors should be considered:

- (a) Blastholes must be sequenced with the initiation point, inter-hole delays, inter-row delays and firing direction shown on the tie-up plan. Where additional or missing blastholes occur, alternative timing options or dummy delays can be employed to maintain the timing between rows and echelons as closely as possible;

- (b) Blastholes are to be connected along rows or echelons, leaving the control 'row' until all other holes have been connected;
- (c) Ensure that surface connections are made in a logical sequential manner, to avoid missed holes, and used according to the manufacturer's recommendations;
- (e) While connecting surface delays at the collar, check downlines for damage (e.g. cuts) that could result in misfire. Place surface clips at the collar to facilitate checking, unless such units require burial;
- (f) The design capacity of surface connectors/clips is not to be exceeded, and outgoing tubes should be parallel (not crossed), with the jaws of the clip closed to retain them;



The design capacity of surface connectors is not to be exceeded, and outgoing tubes should be parallel (not crossed), with the jaws of the clip closed to retain

- (g) Ensure that surface lines are not pulled too tight, and have sufficient slack and tails to allow some freedom to move during firing as burden movement begins;
- (h) Once all holes have been connected, the shot must be visually inspected to ensure all connections have been made correctly, with suitably experienced members of the shot crew checking each other's work;
- (i) When tie-up has been checked, the blast area must be cleared of personnel and equipment, and unused initiating explosives returned to the magazine and properly reconciled;
- (j) Appropriate security and safety controls such as barriers, demarcation, signage and supervision must remain in place to prevent unauthorised or inadvertent access to the blast area, until effective blast clearance has taken place ready for firing. Once surface connection has been completed, a nominated member of the blast crew must stay in attendance until the Shotfirer returns to connect the lead-in line;

9.3 Electronic Systems

When employing electronic detonator initiating systems, the following factors are relevant:

- (a) There is a number of electronic detonator systems available for initiation. These should not be inter-mixed and should only be used in accordance with the relevant manufacturer's/supplier's directions;

- (b) A tie-up plan, with firing times for each hole and deck of explosive and programming/logging path, must be available prior to connection. This may have been generated using a computer program compatible with the electronic system being utilised, or using some other system;
- (c) Electronic detonators should be logged in accordance with the manufacturer's/supplier's recommendations;
- (d) Once programming/logging is complete, test for leakage, missing detonators, and unprogrammed detonators, and rectify where possible;
- (e) Do not use a Blasting Control Box (with sufficient voltage and communication safety protocols to fire a blast) to test the detonators at the shot; these units are only to be used at the firing location after the blast exclusion zone has been cleared;
- (f) Prior to connection, test firing line continuity (if using a wired blasting control box) or radio communication (if using a remote blasting box) to ensure any issues can be rectified prior to firing time;
- (g) Once the blast exclusion zone has been cleared, and the site radio procedures followed, the security system can be enabled and firing procedure for the shot can commence. If necessary, document all error messages during the firing procedure and rectify where possible;
- (h) If the electronic system allows the blast to continue after notifying of potential errors, it is the Shotfirer's responsibility to assess the situation before allowing the blast to continue with known issues;
- (i) Adhere to the specific minimum re-entry times required by each system (depending on voltage bleeding rate) before the post-blast inspection or if the blast is aborted due to an error that requires re-entry. Typical minimum re-entry time is 5 minutes post-firing as long as there is no fume or fire visible;
- (j) Never connect electronic detonators to energy sources other than those designed to be used with the specific systems;
- (k) Never connect conventional electric detonators to electronic detonator circuits or electronic detonator control equipment;
- (l) Never connect electronic detonators from different suppliers to the same circuit or different suppliers' electronic detonator control equipment;
- (m) Never use an electronic system unless trained in its use and passed as competent by the supplier. Always use approved electronic system devices and hardware for each system;
- (n) Ensure the security system which allows firing of the electronic system is secure;
- (o) When lightning is suspected to have hit the general blast area, re-test all detonators for leakage and damage and remove any damaged detonators from the control line – do not attempt to fire downlines showing heavy leakage or damage.

10. EMERGENCY RESPONSE

Emergency scenarios relevant to on-bench activities include those that could lead to the unplanned detonation of explosives, such as lightning strike, fire on an explosives vehicle, heating caused by elevated temperatures or reactive ground, and those that could result in significant misfire risks such as major wall failure above a blast area or flooding. These scenarios are managed according to site emergency response procedures.

In the event of an emergency situation that could lead to unplanned detonation, all personnel working within the designated Blast Exclusion Zone must be evacuated. Blast guards must be posted to the relevant positions to ensure that the effects of any potential unplanned initiation are minimised.

In the case of lightning, established response procedures should define how to identify the point at which an approaching thunderstorm is considered a risk; the communication and clearance protocols necessary to evacuate and secure the emergency blast exclusion zone; and re-entry procedures. Storm warning systems should be utilised so that sufficient time is available to empty MPU hoses and augers, evacuate equipment and personnel, and secure safe exclusion zones around the blast area and explosives vehicle park-up area.

In the case of a fire on an MPU or an explosives transport vehicle an attempt to extinguish must only be made if the fire has been witnessed to have just started, if it is safe to do so (i.e. not directly associated with an AN, ANE or explosives storage area), and the person has been appropriately trained.

In such cases, an emergency is to be called on the radio, the vehicle fuel isolated and the fire managed with on-board extinguishers. Otherwise, the area shall be immediately evacuated and an emergency exclusion zone established, with no other vehicles are to enter the area. The fire will be managed by the fire response team and re-entry prevented until the fire has burned out and the area has been cleared.

Note: Special consideration should be given to the potential for fire at a bench re-load area where significant quantities of AN and ANE may be held on the surface. In such cases, exclusion zones may need to be increased.

In the case of expected flooding or wall failure, where immediate evacuation is not deemed necessary, restricted access may apply while the partially completed blast is prepared for firing to remove an otherwise significant misfire risk at a later time.

In emergency response scenarios, personnel may be directed to close the roadways and access paths to the designated Blast Exclusion Zone for the duration of the emergency event at the discretion of the site management team.

In accordance with site emergency procedures and/or the explosives company emergency procedures, the Blast Exclusion Zone may be altered from the original plan, with due consideration given to the risk potential of the situation. In this event the parameters of the Blast Exclusion Zone will be communicated to all personnel in accordance with site procedures.

11.0 BLAST CLEARANCE, BLAST GUARDING AND FIRING THE SHOT

Blast notification, clearance and shotfiring procedures are beyond the scope of this Code, but must be carried out in accordance with the site blast management system. The **AEISG Code of Practice, “Blast Guarding in an Open Cut Mining Environment”** describes blast notification and clearance, blast guarding, shotfiring, and the post-blast assessment of NO_x gas and misfires in more detail.

A number of factors associated with on-bench 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:

- (a) Are there any over-loaded or under-burdened holes that could not be rectified?
- (b) Were any potential misfire risks identified during charging, that have not been rectified?
- (c) Does the presence of broken ground increase the risk of flyrock, overpressure or fume, from otherwise apparently well contained areas?
- (d) Is the blast in an area with a known history of generating post-blast fume? Has the shot been sleeping longer than usual? Has slumping of blastholes taken place during loading? This may indicate an increased potential for NO_x generation and subsequent transmission outside the blast danger zone, or mine site;
- (e) 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?;
- (f) Are there any ground stability issues that will require further assessment after the blast has been fired and delay re-entry?;
- (g) 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.

12.0 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.

While not strictly within the scope of this Code of Practice, it is not uncommon for a shot crew to return to an adjacent area after firing, in order to commence work on the next blast. Alternatively, mining personnel may return to an area after firing, in order to commence excavation.

Some considerations prior to commencing work include:

(a) The Shotfirer has confirmed that all explosives have detonated, that no misfires are evident, and that the shot has fired satisfactorily;



Post-blast inspection must be completed by the Shotfirer(s), prior to re-entry by other personnel (source Dyno Nobel AP).

(b) Any unsafe wall or crest conditions, or blast damage to the adjacent blast area, has been identified and either made safe or barricaded to prevent access;

(c) Blast performance outcomes (fragmentation, movement, blast damage, environmental impact etc.) have been reviewed, and confirmation provided that subsequent blast designs remain appropriate. If not, blast packs may require update with respect to blasthole layout, charging, stemming and tie-up;

(d) No site personnel, including the blast crew, can return to an adjacent loading area until the all clear has been given, this will include sufficient time for dust and/or fume dispersal;

(e) Access to, and effective demarcation around, the new blast area has been established, with windrows along new blasted boundaries;



- (f) Drilling requirements in the join-up area and in any previously drilled areas have been established, before further charging commences;
- (g) A documented blast hand-over process is observed, 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;
- (h) All relevant documentation associated with blasting activities needs to be completed in accordance with site and/or company procedures wherever relevant.



APPENDIX A: DOCUMENTS REFERENCED

- AS2187.0 - 1998 Explosives – Storage, transport and use – Terminology.
- AS2187.1 - 1998 Explosives – Storage, transport and use. Part 1 – Storage.
- AS2187.2 – 2006 Explosives – Storage, transport and use. Part 2 – Use of Explosives.
- Australian Code for the Transport of Explosives by Road and Rail, Edition 3.
- Blast Guarding in an Open Cut Mining Environment, AEISG Code of Good Practice
- Elevated Temperature and Reactive Ground, AEISG Code of Practice
- Prevention and Management of Blast Generated NO_x Gases in Surface Blasting, AEISG Code of Practice
- Mobile Processing Units, AEISG Code of Practice
- Australian Code for the Transport of Dangerous Goods by Road and Rail, Seventh Edition.

APPENDIX B: EXAMPLES OF BLAST MANAGEMENT DOCUMENTATION

Blast Management Details		Insert Site Here		
Site	Site: Insert	Address: Insert	Office Ph: Insert	
Blast ID				
Proposed Blast date and Time	Date:	Time:		
Key Appointments	Title	Name	Signature	Contact Ph
	Site Manager or Authorised controller			
	Blasting Engineer			
	Blast Author			
	Shotfirer name & Licence No			
Location of proposed Blasting	Reference Job Pack – Pit plan overview			
Blasting Type	Production			
Site Permits / Licences	Details to be sourced from site			
Blasting approval Authoriser	Site Manager: Insert name			
Risk Management Assessment Details	<ul style="list-style-type: none"> Shotfirer Daily Take 5 contained in Job Pack Customer site risk assessment TBC 			
Blast plan including Hole depths	Reference Job Pack – Blast design plan			
Detonation sequence / MIC /Pf Method of Initiation	Reference Job Pack – Initiation plan & blast evaluation and usage report			
Type of Explosives and quantity	Reference Job Pack - Blast evaluation and usage report / IE issues log			
Firing Equipment and Procedures	Reference Orica Shotfirer's Standard Operating Procedure			
Drilling Procedures	Details to be sourced from Site			
Loading and Charging procedures	Reference Orica Shotfirer's Standard Operating Procedure			
Storage and handling procedures	Reference Orica Shotfirer's Standard Operating Procedure			
Security procedures for site blast including explosives	Insert transport procedure or site magazine procedure			
Environmental Considerations	Insert site monitoring conditions if applicable and environmental limits			
Communication	Insert Site UHF channel			
Warning Procedures	3 siren firing sequence		Responsible personal: Insert Site or Shotfirer	
Traffic Management	All site speed limits apply. Minimum 10 m clearance for inner blast exclusion zone. Extra blast signage and barricades to be used at discretion of Shotfirer			
Notification of affected parties if applicable	Details to be sourced from site			
Influence of Weather	All blasting activities to continue unless severe weather patterns intervene. Cessation of blasting will be conducted in accordance with Orica Shotfirer's Standard Operating Procedure			
Misfire Management	Reference Orica Shotfirer's Standard Operating Procedure			
Post Blast assessment and inspection procedures	Reference Orica Shotfirer's Standard Operating Procedure			
Post Blast comments	Reference Job Pack - Blast evaluation and usage report			

JOBPACK CHECKLIST

Site _____ BA _____

Surveyor – Markout:

X Required/ NA Not applicable

SIS (either with surveyor or printed and placed in Jobpack)	
Name of surveyor on front of Jobpack	
Blast classification on front of Jobpack	
Volume calculation/method used on front or inside front flap of Jobpack	
TAKE 5/ Risk Assessment	
Survey station plan (either in Jobpack or on back of Jobpack)	
Survey plan (plan view of blast with summary window)	
Blast markout calculations report (to give to driller)	
Risk indemnity form (if required)	
CD with sp2 file	
Blank timesheet (with surveying time filled in)	
Blank blast summary sheet	
Blank service acknowledgement form	
Blank dip sheet	

Surveyor – Boretrak

On the Job Prestart Check (Take 5 or Risk Assessment)	
Completed dip sheet with short/deep holes noted	
Face profile sheets	
Timesheet (with boretraking time filled in)	
CD with CDL and CDP files	
Blast Risk Notification Form (if significant amount of short/deep holes)	

Shotfirer:

SIS (either with shotfirer or printed and placed in Jobpack)	
Shotfirer's Standard Operating Procedure (accessible by shotfirer)	
Shotfiring procedure at site (Site specific if required)	
Loading chart (filled in by truck operator)	
Face profiles with appropriate downloads noted	
Initiation plan (tie up)	
Delay plan for non-electric blasts (times when holes are detonated)	
Sequence plan for electronic blasts	
Angle of initiation plan (contours)	
Time envelope	
TAKE 5	
JSERA/s / Risk Assessment	
Blast Risk Notification Form (if outside of SIS specifications)	
IS issues log	
Vibration/airblast report – waveforms	
CD with sp2 file (with tie up), footage of blast and relevant vibration/airblast information (see above)	
Completed bulk delivery docket	
ROG fax for CSR (?) and what other BBS paperwork required?	
Completed timesheet	
Completed blast summary sheet	
Completed Visual Blast Assessment form	
Completed service acknowledgment form	

To give to customer:

Service acknowledgment form		Initiation plan	
CD with footage of blast		Vibration/airblast report (if required)	

Site:	High Wall, End Wall or Dig Face Toe area-Risk Assessment For access within 10m of the Toe		
Date _____	Pit Location _____		
OMS Representative _____			
Customer Representative _____			
OMS Sustainability Officer _____			
Assessment only valid for 1 day			
Factor	Risk Rating		
	Low	Moderate	High
Un Bench Height	<35m	35 to 75m	>75m
Joints, Faults and dykes	none	yes but limited length	yes
Inclination of Floor and strata	constant downward dip into highwall	horizontal or moderately variable	floor / strata dips back into pit (dip reversal)
Loose material on crest or wall	none	minor only	yes
Raggedness after trim	minor or none	<0.5m relief on wall	>0.5 relief on wall
Open Fractures in Face (>5mm wide)	<1m in 5m	1-5 in 5m	>5 in 5m
Buffer Blasted Walls	on design	irregular, some relic jointing or caprock	over-steep or undercut. Joints common & open
Seepage above inspection area	none	damp face only	trickling, running water
Evidence of Previous falls	none	occasional, small blocks or short rill (1 - 3m)	recent or large blocks present or rill >3m
Any work above	None	Adjacent to area, but not directly above	yes
Previous Days weather	dry, calm	frequent showers or windy	heavy rain or strong gusts
Current Weather	dry, calm	Light Drizzle or windy	Raining or gusty
Notes			
If no HIGH Ratings and less than three MODERATE ratings, access may be approved by ?????(assessors)			
Signed _____	Signed _____		
If any HIGH ratings and / or four or more MODERATE Ratings, refer to ????? Assessor who will determine whether access can be approved and what controls must be in place			
Assessors recommendation's or requirements			
Assessor's Signature			

APPENDIX C: COMPLIANCE CHECKLIST

AEISG Code: On Bench Practices for Open Cut Mines Edition 3	Date:
Site/ Project:	

Compliance Details:

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
1.0 SCOPE All On-Bench Practices fully conform to the requirements set out in the code.			
2.0 DEFINITIONS Refer to definitions in code used throughout the document.			
3.0 GENERAL REQUIREMENTS			
3.1 Personal protective and special equipment.	All specialised personal and special protective equipment is approved for the task.		
3.2 Competencies and training	A training system exist and includes competencies for: <ul style="list-style-type: none"> • Induction program for all employees. • Training package for working with explosives • Training package(s) for using explosive systems electric or signal tube delay detonators, detonating cord, electronic initiation systems, presplit products • Training in the proper use and care of equipment. • Training in emergency response evacuation procedure. 		
3.2 Competency	<ul style="list-style-type: none"> • Vehicle competencies and authorisations • Competency and authorisation of employees (including licensing and security clearance). 		

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
	<ul style="list-style-type: none"> Competency and authorisation of employees Shotfirer, Assistant Shotfirer, Magazine Keeper, Blast Controller & Blast Guard Demonstrated competence in relation to agreed radio protocols. A record of personnel who are deemed competent and who are authorised to access explosives and precursors. 		
4.0 RISK ASSESSMENT			
4.1 Risk Assessment	<p>A detail risk assessment has been conducted and includes hazards and controls associated with the management of:</p> <ul style="list-style-type: none"> Planning and design Bench preparation and demarcation Priming, charging and stemming blastholes Blast clearance & shotfiring 		
4.2 Factors Considered in Assessing Risk	<p>Does the risk assessment consider?</p> <ul style="list-style-type: none"> Location of protected works Known and likely geological factors including ground water and voids. Access to/ from the blast area Interaction with other mining processes such as drilling and excavation. Slips, trip fall, and manual handling hazards. The application of specific bulk products i.e. suitability of for use in elevated temperature conditions. previous history of flyrock, over pressure or dust. Forecast weather conditions. 		

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
	<ul style="list-style-type: none"> • Location of equipment and personnel at time of firing and radio communication black-spots • Documented blast design parameters (hole diameter, burden and spacing). 		
5.0 BLAST PLANNING AND RECORD KEEPING			
5.1 Blast Planning.	The blast plan and design has considered the equipment to be used to ensure all blastholes can be safely accessed drilled to depths and angle.		
	<p>Has the Interaction between drilling equipment and blast crews been minimised to prevent unnecessary additional risk including?</p> <ul style="list-style-type: none"> • noise and dust levels; • potential for fluid injection injury if there is a hydraulic line burst; • clearance separation from the front deck of 2x drill rod lengths in case the drill rod dislodges from the carrousel; • access to the drill rig for servicing and in an emergency; and • a delineated exit path for the drill at the completion of drilling. 		
	<p>The sleeping of blasts has been assessed with consideration given to:</p> <ul style="list-style-type: none"> • maintaining restricted access and explosives security, • appropriate demarcation, guarding and supervision. To also be effective during any night shifts. 		

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
5.2 Record Keeping	<p>Do the blast records include summary sheets showing;</p> <ul style="list-style-type: none"> • blast pattern, total drill metres, • bulk explosives requirements, design powder factor, stemming requirements, and quantities/types of initiating explosives and blasthole accessories. • Risk assessments for various stages of the process • Drill pattern showing blasthole layout blasthole ID and • Depth angle, direction and diameter of all blastholes. • Charge sheets detailing location of primers charge mass and length. 		
	<p>The blast records contain copies of the tie-up plan</p> <ul style="list-style-type: none"> • Blast clearance plans • Magazine records • Bulk explosives delivery records • Manifests carried on any vehicles carry initiation explosives • The shotfirers daily report • A video record of the blast event. 		
6.0 BENCH PREPARATION AND DEMARCATION			
6.1 Bench Preparation	<p>Adequate bench preparation is provided to suit all equipment operating on the blast bench, including drills, MPU's, stemming equipment, light vehicles, refuelling vehicles and water carts. Bench preparation includes adequate turn-around room, or drive-through access, for vehicle traffic on/through the blast area, such that vehicles do not need to tram over blastholes is provided.</p>		

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
	<ul style="list-style-type: none"> • A minimum stand-off distance is provided from high-walls of 10m • The high-wall clearance zone is delineated with a catchment berm. • The crest berm or windrow is constructed equivalent to half the height of the largest vehicle wheel working on the bench. 		
	Bench surfaces are adequately prepared to provide a safe work area for the shot crew without unnecessary trip/fall hazards or climbing required.		
	A designated vehicle parking area and tipping areas for stemming material are established on the blast area.		
6.2 Demarcation and Communication of Active Blast Area	Physical demarcation and signage is in place to prevent access to the blast area (or on bench reload area).		
	A traffic management plan is used to define entry/exit points for vehicles, park-up areas reload areas, and the required loading sequence.		
7.0 MEASURING AND PRIMING OF BLAST HOLES			
7.1 General	A process is in place for measuring and priming blastholes that includes: <ul style="list-style-type: none"> • Charging activities are not compromised by other/ other activities. • A clear blasthole identification system is implemented. • A clear path is defined for drill rigs when redrills are required. • Over drilled blastholes are backfilled with drill cuttings. • Abandoned blastholes are identified and fill with stemming material. 		

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
	<ul style="list-style-type: none"> Procedures for elevated temperature and/or reactive are in place. 		
7.2 Measurement	<ul style="list-style-type: none"> All blastholes are measured prior to charging Blastholes are measured with a Non-ferrous weighted tape or cord. Adjusted charge quantities, gravel decking and increased stem heights are implemented in front rows to reduce flyrock or overpressure risk. Temperature measurements are conducted and recorded for reactive or hot ground. 		
7.3 Priming	A record of initiating explosives taken from the magazine, used, and returned to the magazine, is maintained.		
	<ul style="list-style-type: none"> Boosters and detonators are kept separate until placement in the blasthole. Boosters and downlines are secured with a peg at the collar of blasthole. Initiating explosives are placed on the same side of each blasthole away from charging stemming equipment. In water-filled blastholes the primer(s) is lowered to the bottom of the blasthole and pulled up into the explosive column as it is charged. Primed, downlines are secured at the blasthole collar. 		
	<ul style="list-style-type: none"> Primers are not left unsupervised overnight in uncharged blastholes. All waste packaging is collected, and dispose of according to site waste management practices. 		

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
8.0 CHARGING & STEMING BLASHOLES			
8.1 Bulk Explosive selection and Delivery	Bulk explosives are charged under the supervision of the Shotfirer.		
	Blasthole loading is sequenced in such a manner that water displaced from wet holes does not run into previously loaded dry holes.		
8.2 Managing vehicles in blast area	<p>A spotter is used to assist the MPU operator to manoeuvre close to:</p> <ul style="list-style-type: none"> walls and crests, in close proximity to blastholes on tight patterns, when reversing or turning around on the bench, in any situation where, restricted visibility presents a risk. 		
	Blastholes are charged systematically, in sections on large shots.		
8.3 Charged quantities	<ul style="list-style-type: none"> Column rise during charging is checked Bulk explosive cup or bucket densities are routinely checked each load. Excess product has been removed from overcharged blastholes. Charging is halted if bulk explosives appear to be running away. The location of overloaded blastholes is communicated to the Shotfirer 		
8.4 Stemming	<ul style="list-style-type: none"> Stemming is placed to design depths with column height checked after charging. 		
	<ul style="list-style-type: none"> Stemming does not commence in gassed blastholes until explosives have had sufficient time to reach their design density 		

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
9.0 SURFACE TIE-UP			
9.1 General	Consideration is given to <ul style="list-style-type: none"> Removal of non-essential vehicles from blast area The number of surface delays required for the tie-up Slumped holes are topped up with stemming and recorded Weather conditions 		
9.2 Signal tube systems	Initiation point inter-hole and inter-row delays and firing direction are shown on a tie up plan.		
	Blastholes are connected along row or echelons leaving control row until last.		
	Downlines are checked for damage when connecting surface delays.		
	Design capacity of connectors is not exceeded and Surface lines are not pulled to tight.		
	At completion of tie up the shot is visually inspected by shotfirer.		
9.3 Electronic systems	A tie-up plan exists for each hole/deck and programming/logging path is available for connection.		
	Test for leakage is conducted Test of firing line continuity or radio communication is conducted prior to firing.		
10.0 EMERGENCY RESPONSE			
	Emergency response scenarios exist for all on-bench activities that include; <ul style="list-style-type: none"> Lightning strike Fire on an explosives vehicle Heating caused by elevated temperatures or reactive ground. 		

AEISG Section	Relevant Requirements	Describe what is in place to demonstrate compliance	Complies? (Y/N/NA)
11.0 BLAST CLEARANCE, BLAST GUARDING AND FIRING OF SHOT			
	Blast guarding procedures are aligned with the AEISG code of practice Blast guarding in an open cut mining environment.		
	Consideration is given to; <ul style="list-style-type: none"> • Over loaded or under-burden holes • the presence of broken ground increasing the risk of flyrock, overpressure or fume 		
12.0 POST BLAST ASSESSMENT AND REPORTING			
	A post- blast risk assessment is conducted after the shot is fired and shot firer reports; <ul style="list-style-type: none"> • All explosives have detonated and no misfires are evident. • Any unsafe wall or crest conditions • Access to and demarcation around the blast area is established. 		
	A documented blast hand-over process is observed and communicated by the shotfirer.		
	All documentation associated with the blasting activities is completed in accordance with the site procedures.		

Areas of Non-conformance and Action Plan

Non Conformance Number	Section Number	Action Plan	Action by	Due Date	Completion Date	Comments
1						
2						
3						
4						
5						
6						
7						
8						

Compliance check summary

The observed on-bench practices complies/does not comply with the AEISG Code of Practice – On-Bench practices for open cut mines and quarries.

Name of assessor/s Date

Signature/s Date of next review

About AEISG

The Australasian Explosives Industry Safety Group (AEISG) is an incorporated association of Australasian explosives manufacturers and suppliers originally formed in 1994.

Since then, AEISG membership has grown substantially to include most of the Australasian explosives industry. A full list of all current member organisations can be found on the AEISG website, www.aeiscg.org.au

The goal of AEISG is to continuously improve the level of safety and security throughout our industry in the manufacture, transport, storage, handling and use of explosives and related materials.

One of the strategies adopted by AEISG in this regard is to identify areas where improved and consistent standards of operational safety and security need to be applied, and then develop appropriate codes that reflect industry best practice in these areas.

AEISG codes of practice are adopted by members for the benefit of their employees, their customers and the general community. In the interest of promoting safety and security, the codes are freely available on the AEISG website.

To keep abreast of technological advancements, industry progress and regulatory changes, AEISG Codes of Practice are subject to regular review and updated through the issue of amendments or revised editions as necessary. It is important that users ensure they are in possession of the latest edition and aware of any amendments. References to superseded versions should be updated accordingly.

Contact Details: info@aeiscg.org.au

AEISG COP ON-BENCH PRACTICES

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