



Australian Explosives Industry And Safety Group Inc.

Code of Good Practice

**BLAST GUARDING IN AN
OPEN CUT MINING
ENVIRONMENT**

**Edition 1
March 2011**



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About the AEISG

The Australian Explosives Industry and Safety Group (AEISG), originally known as the Australian Explosives Manufacturers' Safety Committee, was initially comprised of representatives from Dyno Nobel Asia Pacific Pty Limited (previously Dyno Wesfarmers Limited), Orica Explosives (previously ICI Explosives), Union Explosives Español (UEE, previously ERT), and Total Energy Systems (TES). It was formed in 1994. Since then, the AEISG membership has expanded and broadened.

Current (March 2011) membership includes:

- ◆ Applied Explosives Technology
- ◆ Downer EDI- Blasting Services Pty Ltd
- ◆ Dyno Nobel Asia Pacific Pty Limited
- ◆ Johnex Explosives
- ◆ Maxam Australia Pty Ltd
- ◆ Orica Australia Limited
- ◆ Thales Australia

The goal of the AEISG is to continuously improve the level of safety throughout our industry in the manufacture, transport, storage, handling and use of, precursors and explosives in commercial blasting throughout Australia.

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PREAMBLE

The use of explosives to break rock is an intrinsically hazardous process. On a mine or quarry site the potential hazards are increased by the need to manage the blasting procedure to protect mine personnel, contractors and the general public from exposure to foreseeable, if unintended, adverse consequences of a blast.

Adverse consequences may include, but not be limited to, one or any combination of the following scenarios:

- Persons inadvertently at risk from flying rock generated by the blast
- Persons at risk from fumes generated by the blast
- Persons at risk from misfired blastholes
- Persons carrying out tasks other than blasting with workplaces inside an area subject to blasting effects
- Electrical storms arriving when a blast is ready to fire
- Unauthorized persons unintentionally driving or walking inside a blasting zone
- Blast effects extending outside the mine boundaries

This Code has been developed to provide practical guidance on meeting regulatory requirements on mine safety. In the event of any conflict between this Code and 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 the recommendations and precautions to protect the community, customers, employees and the environment in relation to the duties and obligations of persons performing all of the roles associated with the process 'Blast Guarding' in an open cut mining environment.
- 1.2 This code does not cover the guarding of explosives against unauthorised access once loading has commenced.

2.0 DEFINITIONS

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

Associated works - Other magazines, process buildings and storages of energetic materials, e.g. ammonium nitrate or Class 5 dangerous goods.



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 site. The site Blast Boards will be updated at least the day before the shift start on the day of firing.

Blast Controller – A person who may be appointed to handle the logistics of the clearance of the Blast Exclusion Zone including (but not limited to) the following:-

- Removal / relocation and preparation of equipment currently within the Blast Exclusion Zone;
- Confirming the position and location of the Blast guards;
- Completing the clearance sweeps of the Blast Exclusion Zone once the guards are in place and the area secured.

Note:- this role may be performed by the Shotfirer in conjunction with his role in the handling and firing of the explosives, or by another suitably qualified person such as an Open Cut Examiner (in a coal mining environment) or Blasting Supervisor.

The extent of the responsibilities of the Blast Controller may be dictated by the degree of activities associated with any individual blast.

Blast Exclusion Zone – The area that is determined by the risk assessment process, to ensure that all the expected / foreseen dangers and affects of the blast, are maintained within a controlled area. The Blast Exclusion Zone may be layered, with an inner zone parameter being defined as the minimum distance for equipment and an outer zone parameter being defined as a personnel zone.

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 act as a hard barrier against unauthorised access to a designated Blast Exclusion Zone.

Post-Blast Fume – The cloud of material generated after the initiation of ammonium nitrate based explosives which is sometimes yellowish through to a red / brown colour. The cloud will generally be composed of the following materials:

- Dust and other soil / rock particulate matter formed / released by the forces exerted on the surrounding rock during the blast;



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 generally conducted at the edge of the delineated shot, prior to the shot being fired. The meeting must include the following personnel:-

- Shotfirer;
- Blast Controller; and
- The nominated Blast Guards.

It should also include:-

- Other personnel relevant to the blast (e.g. Technical Services Representative, Open Cut Examiner or similar relevant position).

A scaled plan / map shall be provided and the topics for discussion will include:

- Blast notifications;
- Blast Guard positions, equipment and role;
- Production and ancillary equipment locations;
- Personnel locations, including the location of all personnel who may be adversely affected by the blast e.g. maintenance personnel;
- Any exceptional circumstances related to the blast; and
- Weather conditions e.g. wind speed/ direction, cloud cover.

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

Shotfirer – A person who uses blasting explosives and is responsible for preparing, charging and firing explosives.

Standard Operating Procedure (SOP) / Standard Work Practice (SWP) - A written procedure containing an explicit description of how a job is to be performed. The SOP / SWP identifies the precautions required to safely complete the task, and should include:-

- Personal protective equipment (PPE);
- Hazards specific to the job and/or site;
- The level of authority, responsibility and training required to complete the job safely;
- Reporting relationships identified by management, and any other relationships that may interact with other jobs, SOPs, SWPs or work instructions.

Unauthorised Persons – Personnel not associated with the firing of the blast and, within the designated Blast Exclusion Zone once the Shotfirer / Blast Controller have closed the roadways and accesses to the designated Blast Exclusion Zone.

Unauthorised Traffic – Personnel operating machinery / vehicles not associated with the firing of the blast and, within the designated Blast Exclusion Zone once the Shotfirer / Blast Controller have closed the roadways and accesses to the designated Blast Exclusion Zone.



3.0 GENERAL REQUIREMENTS

It is the responsibility of all persons involved in the 'Blast Guard' operations to adhere to the company and / or the site specific Standard Operating Procedure or Standard Work Practice prior to participating in the activity.

It is the responsibility of the site Supervisor to ensure all personnel involved in the Blast Guard operations complete training in, and adhere to, the company and / or the site specific Standard Operating Procedure or Standard Work Practice prior to participating in the activity.

It is the responsibility of all persons involved to use Risk Management principles to assess any hazards and implement any necessary controls for any event that may be undertaken where there is risk of personal injury or equipment damage.

The equipment operators must have the appropriate qualifications and be appointed and authorised by the relevant site personnel to operate any equipment used in this process, unless under training, and then in accordance with the site training procedures.

Prior to the operation of any equipment used in the Blast Guard process, all relevant pre-start inspections have to be completed and recorded for all machinery that shall be used in the operation.

Equipment is not to be operated by any person where it is not safe to do so or where further relevant training is required by the person.

3.1 Personal Protective Equipment and Special Equipment for the Task

The personal protective equipment required for the task will be as follows (as a minimum) with all equipment being in accordance with the blasting company and / or the mine site requirements:-

- Approved Hi Visibility Clothing;
- Approved Safety Footwear;
- Approved Eye Protection;
- Approved Hand Protection.

The special equipment required for the task may include the following items:-



- Blast Exclusion Zone plan (including a blasting area specific map);
- Mine site compliant vehicle;
- Suitable 2-way radio communication, including site compliant and working two-way radios;
- Approved roadway closure devices (portable signage, vehicle signage, fixed signage, witches hats);
- Blast guard position markers;
- Global Positioning System unit;
- Traffic Controller's Licence (if required for public road closures).

3.2 Required Competencies and Training

Any person involved in this task must have completed the appropriate company and / or site requirements for the following:-

- a) Induction program for all employees (generic and site based, as applicable);
- b) Appropriate vehicle competencies in relation to the vehicles being utilised in Blast Guard duties;
- c) Appropriate training package for Blast Guarding, including both a theory and practical component by the company and / or mine site;
- d) A mine site familiarisation tour;
- e) Emergency response and evacuation procedures;
- f) Appropriate skills training and licensing of employees as required for operating specialized equipment, or conducting specialized activities e.g. traffic controller; Shotfirer, Blast Controller;
- g) A regular review and renewal of training and licensing requirements (as required by legislation or site requirements);
- h) Site specific personal protective equipment (PPE) requirements and special / task specific requirements, including training in the proper use of and care of the equipment; and
- i) Demonstrated competence in relation to agreed radio protocols.



It is recommended that each site, under their Blast Management Plan (refer AS2187.2 – 2006), maintain a register of personnel who are deemed competent and available to perform the role of a:-

- Blast Guard; and
- Blast Controller.

Such a register may include specific information including:-

- Name;
- Site role;
- Crew / shift;
- Date training completed; and
- Date refresher training required.

3.3 Records

The following records need to be maintained:

- a) Personal Risk Management tools;
- b) Shot Risk assessment;
- c) Blast Exclusion Zone map;
- d) Blast control ancillary information; and
- e) Blast Guard / Blast Controller Register.

4.0 RISK ASSESSMENT

A formal risk assessment should be completed for each blast, identifying the hazards and controls that may be presented by the individual shot at each stage, including the extent of the Blast Exclusion Zone during the firing sequence.

Any risk assessment must be approved and signed by all of the relevant parties involved in the blasting process prior to the blasting process being undertaken.

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

- The type of shot (cast, stand-up, inter-burden, coal parting, etc);
- Aim of the shot (maximum fragmentation, maximum heave, etc);
- The ground type (hardness / bedding planes);
- Known geological abnormalities within the blast design area;
- Burden and spacing (including face row design);
- Average bench height;
- Vertical location of the bench;
- Average blast hole load;
- The designed blast powder factor;
- Timing and effects;
- Historical records of flyrock events;
- Access to and from the proposed Blast Exclusion Zone;
- The location of equipment and personnel during the blast;
- The location of protected works and/or associated works;
- The location of external infrastructure potentially affected by the blasting activities (air, road, rail);
- The formation and management of any blast fume;
- Radio communication 'black spots';
- The expected weather conditions.



5.0 BLASTING NOTIFICATION

The site supervisor responsible for the blasting site activities will notify all persons on a mine site, 24 hours prior to the scheduled blasting time.

The Operational Superintendents and other department heads will ensure the blasting information has been passed on to all personnel under their direct control (including sub-contractors) using the site Pre-shift Meetings and other relevant forms of communication such as e-mail.

All blasting notification shall be presented in a format which includes an agreed or common language used for all site personnel.

Notification may include relevant external parties to the mine site within close proximity of the blasting area (e.g. rural lease / land holders). Notification of these parties may include telephone communications and / or face to face meetings.

The site Blast Boards will be updated at least the day before the shift start on the day of firing. The site Blast Boards should be positioned to ensure that all personnel entering the mine site and / or relevant sections of the mine site, where blasting activities are forecast, have direct visual information relating to the blasting schedule.

The use of flashing lights to identify the 'active' nature of the Blast Board and positioning of the Blast Boards at pre-shift meeting rooms, 'T' intersections or a 'Stop' sign / security gate, preceding entry to the mine site and / or relevant sections of the mine site, where blasting activities are forecast, are recommended where possible.

The Technical Services personnel associated with the blast will provide a scaled plan or map to be presented at the pre-blast meeting.

The Blast Plan and the scaled plan or map should provide the following information:-

- a) A clear view plan of the shot including;
 - i) the blast identification number
 - ii) scheduled time and date of firing
 - iii) the Blast Exclusion Zone for all equipment
 - iv) the Blast Exclusion Zone for all personnel
 - v) the firing position (outside the Blast Exclusion Zone distance but within the area under the control of a Blast Guard)
 - vi) ancillary information relating to the blast e.g. wind direction/speed;



- b) The nominated distances for each Blast Exclusion Zone (equipment and personnel);
- c) All access roads and pathways through the designated Blast Exclusion Zone;
- d) The location of the required Blast Guards and their respective areas of control;
- e) The nominated Shotfirer and / or Blast Controller;
- f) The approval and sign off from the blast design engineer and other relevant site / blast personnel (e.g. Open Cut Examiner, Drill and Blast Supervisor, Shotfirer, Blast Controller, etc);
- g) A list of the names of the individual Blast Guards;
- h) A script of the agreed radio procedures and responses;
- i) A table to record any abnormalities exposed during the procedure.

The blasting schedule will be provided to the designated mine personnel (e.g. Open Cut Examiner) and details such as blasting inspections (sleeping shots and reload areas) shall be entered into the relevant mine reports where the information can be communicated to the general mining personnel at the morning pre-shift meetings.

The communications of blasting activities to the general mining personnel on the mine site should include blast identification, the blast type, the location, Blast Exclusion Zone distances and the firing times.

Additional forms of blasting notification such as:-

- A site specific blasting hotline (e.g. 1300 xxx xxx) which could be a recorded message, providing the site specific forecast blast firing times for all relevant persons;
- A general radio announcement made each day at a nominal time to indicate the blasting requirements of the day.

During the day of the shot, the Shotfirer shall review the site Blast Exclusion Zone plan in conjunction with the other relevant personnel (Technical Services Representative, Blast Controller, Open Cut Examiner) regarding the following:-

- Blast Guard positions;



- Production and ancillary equipment locations;
- Personnel locations, including the location of maintenance personnel;
- Any exceptional circumstances related to the blast.

The Shotfirer / Blast Controller shall confirm that the appropriate people have been notified in relation to machinery and people to be removed from the exclusion zone. (e.g. Pit Foreman, Maintenance Foreman, Pump Crew Foreman, Dragline Operator).

This should be done as early as possible prior to the shot being tied in and again the information shall be conveyed to all at the Blast Guard meeting.

If it has been determined that the blast exclusion area encompasses a public roadway and / or rail line, it will be confirmed at the pre-blast meeting that the relevant authorities have been notified and appropriate controls are in place.



6.0 PUBLIC ROADWAY / RAILWAY CLOSURES / AIR TRAFFIC

The requirements for a person to perform the Blast Guard role and close a public roadway may include the provision of a 'Traffic Controller' qualification, as per the local authority requirements. This should be investigated prior to any public road closure and the nominated persons to perform the role under such circumstances are to be appropriately equipped and qualified for the role.

It should be noted that approval for any diversion of air traffic or closure of any air strip, rail line or public roadway, is required from the appropriate controlling authority body, and is subject to the application and notification of blasting activities within these areas.

The timeframes and required information for such applications will be as per the relevant controlling authority specifications and may vary from state to state.

The Shotfirer / Blast Controller is to ensure that the Blast Guards who are responsible for any public roadway closure, have the appropriate signage positioned on the boundaries of the Blast Exclusion Zone in these areas at least 30 minutes prior to the proposed firing time.



7.0 THE BLAST GUARD PROCESS

The person assuming the role of the 'Blast Controller' will be responsible for the logistical elements of the blast in terms of:-

- a) Prior to the blast guard meeting, ensuring that adequate resources are available to provision the Blast Exclusion Zone in terms of :-
 - i) A suitable number of maps have been provided to assist each blast guard as a reference document for the individual location and specific blast information;
 - ii) The correct numbers of competent personnel required to be blast guards are available and have been advised of the blast guard meeting time and location;
 - iii) The numbers of suitable vehicles required to support/indicate the blast guard locations;
 - iv) Visual indicators associated with each blast guard location;
- b) Ensuring that the designated Blast Exclusion Zone is clear of all personnel and equipment, in accordance with the specification of the blast design, and in accordance with the nominated site timeframes, prior to the firing of any blast, by communication with the relevant mine site personnel supervising non blast related activities within the designated Blast Exclusion Zone;
- c) Establishing the security of the Blast Exclusion Zone perimeter, including the positioning and monitoring (visually and by radio contact) of the blast guards; and
- d) Conducting a safety sweep of the designated Blast Exclusion Zone prior to the firing of the blast to ensure that requirements of the Blast Exclusion Zone design parameters have been met.

Each person designated as a Blast Guard will have two main roles:-

- a) To create a physical barrier at a defined access point to a blast area to ensure no persons can enter the Blast Exclusion Zone during the firing process;
- b) To immediately communicate any breach of the Blast Exclusion Zone to the Shotfirer and / or the Blast Controller.

A sign or barricade is NOT sufficient to ensure that unauthorised persons are NOT within the area of danger prior to blast firing process.



Physical checks and guards are a mandatory part of any blast clearance process.

The obligation of a Blast Guard is to work under the direct instructions of the designated Shotfirer or Blast Controller and no other person for the duration of the blast guarding duties.

The Blast Guards will proceed to the designated Blast Guard points and conduct a complete clearance inspection of their area, checking for personnel and the position of equipment.

During the inspection, the Blast Guards may need to get out of their vehicle as required, to check areas that are not accessible by a vehicle or where machines have been shut down for mechanical repairs, to ensure all persons are evacuated (e.g. crib huts, amenities buildings, temporary buildings, dragline lay down pads).

The Blast Guard must then report the results of the inspection to the Shotfirer / Blast Controller via the 2-way radio and receive confirmation of the message from the Shotfirer and Blast Controller.

The Blast Guard should then establish and man the Blast Guard position. Under NO circumstances will Blast Guards leave their position or relocate their position without consultation with the Shotfirer / Blast Controller.

Once the Blast Guard is in position at the barricade point, the access to the Blast Exclusion Zones is to be closed by a physical barrier, e.g. by parking their vehicle at a 90° angle to the Blast Exclusion Zone access.

The Blast Controller will conduct a safety sweep of the Blast Exclusion Zone once all of the Blast Guards have confirmed that they are in the correct location and their area is clear of unauthorised personnel and equipment by the agreed radio protocol.

Under NO circumstances will the Blast Guards leave their position until the Shotfirer has given the "ALL CLEAR" and confirmed with each Blast Guard via the 2-way radio system that their duties have been completed.

Under NO circumstances shall any unauthorised traffic or personnel be permitted to venture inside the Blast Exclusion Zone past this point until the "ALL CLEAR" from the Shotfirer has been received by the Blast Guard.

In the event that a Blast Guard barricade has been breached or the Blast Guard observes personnel within the exclusion area, the blasting process MUST immediately be stopped by notifying the Shotfirer / Blast Controller via the 2-way radio.



The Blast Guard will immediately call on the designated 2 Way Radio channel “DO NOT FIRE, Guard (guard number)” or similar agreed call, twice and wait for a response from the Shotfirer.

If there is no response from the Shotfirer / Blast Controller within 2-3 seconds the Blast Guard is to make the call again. The Blast Guard will continue to broadcast the radio alert of the unauthorised access, until receiving a suitable response from the Blast Controller or Shotfirer.

The Shotfirer / Blast Controller will acknowledge the radio call from the Blast Guard and then :-

- a) Immediately abort the firing procedure and, disconnect and secure, the explosives initiating (firing) apparatus;
- b) Confirm with the Blast Guard the details of any reported breach of the Blast Exclusion Zone;
- c) Communicate to all Blast Guards to hold their current positions;
- d) Release the radio silence;
- e) Document the details of the reported breach of the Blast Exclusion Zone (blast guard number, time, area, vehicle / person identification, etc.);
- f) Investigate the reported breach of the Blast Exclusion Zone;
- g) Consider what corrective actions are to be taken (e.g. restart the firing procedure / reschedule the firing of the blast).

If there is no response from the Shotfirer / Blast Controller to the initial radio alert from the Blast Guard, a relay radio message may be required to be passed to the Shotfirer / Blast Controller from another Blast Guard, or relevant site personnel who have heard the radio alert call.

The Blast Guard who has witnessed / reported the unauthorised access within the closed Blast Exclusion Zone shall not leave the designated position, to follow or remove any unauthorised personnel, under any circumstances.

Under these conditions the firing of the blast will be delayed, and the designated Blast Controller will investigate all reports of unauthorised access within any closed Blast Exclusion Zone, before resuming the blast firing sequence.

Following investigation, the Blast Controller will provide a report of any unauthorised access to a blast exclusion zone to the site supervisor.



7.1 Selection of Personnel to be a Blast Guard

Personnel selected to be a Blast Guard must have completed all of the relevant site based training which will be associated with this task. Factors which also need to be considered when selecting personnel to be Blast Guards may include:-

- Suitable literacy and numeracy skills for the task (including an agreed common language to be used during all communication between the Blast Guard, the Blast Controller and the Shotfirer);
- Equipment operation competencies;
- Site specific skills and knowledge;
- Physical capability;
- Availability;
- Other competencies or training undertaken;
- Existing responsibilities and accountabilities.

Because Blast Guards have no direct contact with the explosives or the explosives handling process the legislative security requirements that apply to the member of the blast crew do not extend to persons fulfilling the Blast Guard role.



8.0 PRE-BLAST MEETING

At an agreed time (e.g. 60 minutes) prior to the blast firing time the nominated Blast Guards will meet at the blast location.

At this time (e.g. 60 minutes prior to the blast firing time), prior to conducting the Blast Guard Meeting, a general radio announcement will be made to all mine personnel indicating the firing of the blast in 1 hour. This notification should include the blast identification, the blast location and the type of blast. Confirmation of the blast notification from the production superintendent and Open Cut Examiner, where applicable, is required.

The pre-blast meeting must involve the following personnel:

- Shotfirer;
- Blast Controller;
- Blast Guards;

and may include other personnel relevant to the blast. The purpose of this meeting is to discuss:

- a) The Blast Area Exclusion Zone plan;
- b) The designated 2-way radio channel to be used for the blast location;
- c) The firing location;
- d) The issued Blast Guard location information sheets which will indicate:-
 - i) the position of Blast Guards;
 - ii) the Blast Guard positions in relation to any change in the original blast design parameters or identified hazards;
 - iii) the relevant Blast Guard numbers;
 - iv) the process for the clearance of the blast area, including the positioning of machines and any ancillary equipment; and
 - v) any exceptional circumstances relating to the blast.

Prior to completion of the meeting, all Blast Guards shall verify their understanding of the position requirements.

All personnel involved with the blast should conduct a radio check to ensure the allocated radio is on the correct channel and operable before dispersing to their nominated position.

At a time approximately 30 minutes prior to the firing of the blast, the Blast Controller will confirm with the Blast Guards via the 2-way radio that they are in their allocated positions. Confirmation from each Blast Guard is required.



9.0 ESTABLISHING THE BLAST GUARD POSITION FOR THE SHOT

Blast Guard positions are to be identified and marked, prior to the loading of the designated blast area.

The positions can be identified by a site specific process and marker (e.g. coloured witches hat) with the distance to the shot being verified using the preferred method of a Global Positioning System unit analysis. This will provide personnel with a clear Blast Exclusion Zone marker in the event of having to close the Blast Exclusion Zone during a thunderstorm or an emergency event.

It is to be noted however, that hazards identified during the loading of the blast (e.g. overloaded blast holes, insufficient face row burden, geological abnormalities) or a change to the blast parameters (e.g. to meet a revised mining schedule, driven by a significant weather event) may then require the original Blast Guard positions to be reviewed and changed, in accordance with the requirements or conditions of the blast design.

Prior to the shot being fired, the Blast Guards must be in position at an agreed time (e.g 30 minutes) before the blast. This may vary depending on the clearance area and hence will be site specific.

Once asked to close access to the Blast Exclusion Zones, the Blast Guard vehicle is to be parked in a position that blocks the access to the exclusion area and is clearly visible to all oncoming traffic.

Each designated Blast Guard vehicle will have a working flashing light activated (hazard lights may be used as well) and have 2 way radio communications (either hand held or vehicle mounted) with the nominated Shotfirer and Blast Controller.

In the event of the designated Blast Guard position being located in a radio 'black spot', the position may need to be relocated to an alternative position where clear radio communications can be clearly established prior to the firing of the shot. This action will be completed through consultation and with the approval of the Shotfirer and Blast Controller.

The Blast Guard position will allow clear vision of the position access along roadways and the surrounding area and shall not be located in a position that can cause confusion or place the blast guard in danger from moving traffic (e.g. on corners, directly on intersections, etc.).

Blast Guards must remain with the vehicle and ensure there is ready 2-way radio communications during the Blast Guarding process.

Once in position, no unauthorised traffic or personnel will be permitted to pass the Blast Guard location, unless evacuating the exclusion area, or in an event of an emergency.



The Shotfirer / Blast Controller must be notified immediately via the 2-way radio of any emergency condition.

If a public roadway is to be closed, all vehicle traffic will be stopped at the Blast Guard position and a clearance run of the section of roadway must be completed between the Blast Guard positions at least 5 minutes prior to the firing of the shot.

In most cases involving railways the rail authority will manage the closure, clearance and re-opening of the rail corridor.

The Shotfirer / Blast Controller must then be notified that the public roadway and / or rail line are all clear within the blast exclusion area.

9.1 Blast Guarding During a Thunderstorm

In the event of a thunderstorm approaching a loaded or partially loaded shot, all personnel working within the designated Blast Exclusion Zone must be evacuated, with blast guards posted to the relevant positions to ensure that the effects of any potential unplanned initiation caused by a lightning strike are minimised.

In this case, personnel may be directed to close the roadways and access paths to the designated Blast Exclusion Zone for the duration of the storm at the discretion of the site management team.

In such cases, the location of blast guards must take into account risks from lightning and/or flooding.

9.2 Blast Guarding During an Emergency

In the event of an emergency situation on a loaded or partially loaded shot, all personnel working within the designated Blast Exclusion Zone must be evacuated, with blast guards posted to the relevant positions to ensure that the effects of any potential unplanned initiation caused by fire and / or any other potential ignition source are minimised.

In this case, 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 the 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 by a member of the site management team or a delegated authority.



10. CLEARING THE BLAST EXCLUSION ZONE

The Blast Controller will conduct a safety sweep or clearance of the Blast Exclusion Zone once all of the Blast Guards have confirmed that they are in the correct location and the area is clear of unauthorised personnel and equipment by the agreed radio protocol.

Prior to conducting the sweep of the Blast Exclusion Zone the Blast Controller will familiarise himself/herself with the operations and work areas currently in use within the designated Blast Exclusion Zone.

During the sweep of the Blast Exclusion Zone the Blast Controller will notify each blast guard of his/her travel through their area of concern.

The Blast Controller will verify the position and conformity of the Blast Guard position during the sweep.

All areas within the Blast Exclusion Zone will be inspected for unauthorised personnel and equipment.

At this time, with the Blast Guards in position and their immediate area secure and all traffic flow stopped, the Shotfirer / Blast Controller must complete a full clearance inspection of the designated Blast Exclusion Zone to ensure the following:-

- a) All personnel have been removed from the designated Blast Exclusion Zone;
- b) Where possible, all equipment has been removed from the designated Blast Exclusion Zone. A risk evaluation (e.g.- reference to the equipment in the original blast risk assessment or a specific JSA for the equipment within the Blast Exclusion Zone) will be conducted and documented to identify and implement suitable controls to minimise any potential equipment damage from the blast;
- c) As a minimum requirement all equipment that cannot be removed must:-
 - i) Stop operation and shutdown;
 - ii) Be appropriately isolated;
 - iii) Be secured against the effects of the blast.

During the inspection, the Shotfirer / Blast Controller may be required to leave the vehicle to check any areas that are not accessible by vehicle, to ensure that all persons have been evacuated (e.g.- crib huts, amenities buildings, temporary buildings).



In this case the Shotfirer / Blast Controller must remain in direct radio contact to the Blast Guards by the use of a hand held 2-way radio.

In areas such as crib huts, amenities, temporary buildings, banded work areas and parked machinery where personnel may be working remotely or out of radio contact, the Blast Controller may use a device, such as an audible alarm upon entry to the area, to alert personnel to his/her presence and await any response.

On completion of the clearance inspection, and when the Shotfirer / Blast Controller is satisfied the Blast Exclusion Zone is clear:-

- a) The Blast Controller will hand the control of the shot over to the Shotfirer who will commence the firing sequence, beginning with a warning (e.g. 10 minute) to all site personnel in accordance with the company and / or mine site blast firing procedures. During this time the blast initiating mechanisms will be installed and prepared for firing.
- b) The Shotfirer will then commence the firing sequence with a 2 minute warning to all site personnel. This will include a final check of the area by radio with each Blast Guard.



11.0 FIRING THE SHOT

The Blast Controller will advise the Shotfirer that the Blast Guards are in position and the Blast Exclusion Zone is secure and clear of unauthorised personnel and equipment.

The Shotfirer will raise any concerns regarding the blast guards and / or the clearance procedure before accepting the control of the blast and designated blast area.

The Shotfirer will confirm that he/she has received and understood that he/she now have the control of the blast and designated blast area.

The Shotfirer will call for radio silence at the 2 minute mark from the firing time; silence shall be maintained unless an emergency situation arises.

The Shotfirer will call all Blast Guards, each guard will respond by clearly stating "Guard (guard number) is in place and the area is secured".

By using the agreed radio protocol to confirm the security of the Blast Exclusion Zone and announce the 2 minute warning, the Shotfirer has accepted control of the blast and the designated Blast Exclusion Zone.

The Shotfirer will call a two minute warning prior to firing.

The Shotfirer will broadcast a 15 second warning alarm over the 2 way radio system prior to firing.

NOTE:-

If the Blast Guard position or exclusion area is breached at any stage in this process, the Shotfirer must be immediately notified via the 2-way radio to stop the firing sequence by the Blast Guard.

The Blast Guard will immediately call on the designated 2-way radio channel "DO NOT FIRE, Guard (guard number)," or similar agreed call, twice and wait for a response from the Shotfirer, and will continue to do so until there is a response from the Shotfirer.

The Shotfirer will complete the site firing procedure in accordance with the site accepted practices and fire the blast.



11.1 The Management of 'Post-Blast Fume'

Sometimes large clouds of 'Post-Blast Fume' are generated after the initiation of ammonium nitrate based explosives, which may be yellowish through to a red / brown colour. The cloud will generally be composed of the following materials:

- Dust and other soil / rock particulate matter formed / released by the forces exerted on the surrounding rock during the blast;
- Water vapour;
- Carbon Dioxide;
- Carbon Monoxide; and
- Oxides of Nitrogen (NO_x)

Oxides of Nitrogen (NO_x) are a mixture of gases that are composed of nitrogen and oxygen. Two of these gases are nitrogen dioxide and nitric oxide, which are known to have toxic affects.

Any person who experiences the subsequent symptoms following exposure (low level exposure symptoms only) to 'Post-Blast Fume' must seek immediate medical treatment. Such symptoms include:

- a) Irritation to the eyes, nose, throat and lungs;
- b) Coughing and shortness of breath;
- c) Tiredness and nausea;
- d) A build up of fluid in the lungs (possibly taking 1 -2 days).

Some of the factors known to affect / lead to the production or formation of Oxides of Nitrogen (NO_x) in particular are:-

- a) Use of emulsion formulation which is deficient in oil content or rich in ammonium nitrate content;
- b) Poor diesel absorption by ammonium nitrate prill;
- c) Water ingress in products as the product exceeds sleep time limits;
- d) Critical density of the products used;
- e) Poor loading (often hose handling) practices;



- f) Critical diameter of the blast holes ;
- g) Product desensitisation by pressure;
- h) Other contributing factors may include:-
 - i) Ground conditions such as presence of cavities, cracked ground;
 - ii) Lack of proper confinement (stemming of blastholes);
 - iii) Presence of dynamic water within the blastholes;
 - iv) Direct contact of incompatible chemical compounds (e.g. gassing agents).

The most effective way to manage 'Post-Blast Fume' is to manage the factors known to contribute to the formation of the Oxides of Nitrogen (NO_x). The following factors, if managed well at a blast crew level, may assist in reducing the formation of the fume during the detonation phase of a blast:

- Ensure the Mobile Processing Units and other equipment are calibrated;
- Always load the product using the appropriate techniques;
- Proper operation of the Mobile Processing Units and equipment;
- Ensure the gassing agent delivery rates are correct;
- Ensure effective stemming is in place;
- Monitor the amount of hydrocarbon (diesel) in the product;
- Keep ammonium nitrate dry;
- Report any abnormalities in the manufacture or loading process.

The following personnel have been identified as those generally at the greatest risk of exposure to Oxides of Nitrogen (NO_x) during the explosives detonation process:-

- a) Shotfirers and Support Personnel may be exposed to the Oxides of Nitrogen (NO_x) gases during the post blast period by moving back into the general blast area prior to the dispersion of the gasses;
- b) Shotfirers and Support Personnel may be exposed to the Oxides of Nitrogen (NO_x) gases during the post detonation inspection of the blast area as the dispersion of the gasses can be very localised and continue to leak from under the ground for some time after the initial blast;
- c) Shotfirers and Support Personnel may also be exposed to the fume cloud during the blast guarding process;



- d) General mining personnel who may be exposed to the production of the NO_x gases during the dispersion of the 'Post-Blast Fume' cloud across a site;
- e) Personnel that gather at areas such as blast guard positions and crib huts, close to the edge of the Blast Exclusion Zone.

Such personnel need to be monitored during the 'Post-Blast Fume' dispersion to ensure personnel in any exposed positions are advised and take appropriate actions.

As a part of the Blast Guard procedure, the formation and direction of all 'Post-Blast Fume' clouds must be monitored by the Shotfirer / Blast Controller.

Blast Guards may also report the direction of any 'Post-Blast Fume' clouds if they consider their position to be at risk of exposure to the cloud.

In the event of Post-Blast Fume moving away from the blast towards a known Blast Guard location, the Shotfirer / Blast Controller may direct the personnel at that particular location to:-

- a) Withdraw from their present location to an alternative position along the roadway or access pathway;
- b) Remain in side any vehicles or crib huts with the windows closed and the air conditioner on re-cycle.

While it is unlikely that exposure to these gasses will result in a fatality due to the concentration of the gasses in an outdoor / well ventilated mining area, the Oxides of Nitrogen (NO_x) must be recognised as a potential threat and managed accordingly.



12.0 BLAST FIRED

Once the blast has been fired, the Shotfirer will lift the radio silence and state: “All Blast Guards are to remain in their position until the “ALL CLEAR” is given”.

The Blast Controller will visually monitor the effects of the blast, before allowing the Shotfirer to return to the blast site, and make an assessment as to the potential risks associated with any post-blast inspection.

The assessment shall consider the minimum waiting time prior to conducting the post-blast inspection, and include (but not necessarily be limited to) consideration of the following factors:

- The recovery and securing of all types of initiating devices from firing lines;
- Whether there is a need for more than one person to return to the shot for the inspection;
- Whether fume dispersal has occurred;
- Whether dust dispersal/settlement has occurred;
- The identification of any apparently unstable ground;
- The safety and suitability of access and egress;
- Aspects of the blast that may indicate that not all of the charges have been initiated;
- In the case of a misfire, or a suspected misfire, whether the minimum waiting time has been observed;
- The availability of a competent person to inspect for safety, ground or material that did not move as intended;
- Who may enter the exclusion zone prior to conducting the post-blast inspection.

When advised by the Blast Controller, the Shotfirer will then inspect the blast and may confirm the “ALL CLEAR” after giving due consideration to:-

- Identification of any misfire and / or the associated corrective action required to make the area safe;



- Procedures to be adopted, if the inspection reveals that the “ALL CLEAR” cannot be given;
- Continuous inspection procedures during the approach to the post-blast site that might identify unusual or abnormal results indicating possible hazards;
- Whether there is a need to wash down/or scale exposed surfaces;

The Shotfirer may then communicate:

- that a misfire or other problem has been identified and the “ALL CLEAR” cannot be given and that further action is required, or
- that the “ALL CLEAR” has been given and that normal operation may recommence.

Where the “ALL CLEAR” has been given by the Shotfirer, the Blast Controller will then release the Blast Guards in numerical order. (Blast Guards must reply to the message).

Blast Guards will acknowledge the “ALL CLEAR” message.

The rail authority personnel will generally control the rail line clearance and re-opening in accordance with the communication from the Shotfirer/ Blast Controller or a designated Blast Guard.

The Blast Guards performing the traffic control operations on any public roadway are to remain in place at the designated public roadway positions until such time as:

- a) The “ALL CLEAR” is given by the Shotfirer; and
- b) Before traffic flow resumes, the section of the roadway between the Blast Guard positions must be inspected for blast debris with the removal of any material that may have landed on the roadway.
- c) This inspection is performed by the nominated third person who is in position with the Blast Guard prior and during the blast.
- d) Following the inspection of the public roadway, the Shotfirer may allow the resumption of traffic flow on the public roadway during the post blast inspection timeframe at their discretion, taking into consideration all due circumstances, however the Blast Guards will remain in position until the ‘All Clear’ has been given and confirmed.



NOTE: Until the “ALL CLEAR” signal is given, no traffic or personnel are permitted to gain access to the mine site blast area (This is to allow for the treatment of any misfires found with the possibility of re-firing at the time.).



13.0 MISFIRE MANAGEMENT

In the event of a misfire being declared by the Shotfirer, all Blast Guards are to remain in position and ensure that the 'no access' to the blast area is maintained.

A misfire may include:-

- a) The total failure of the blast to initiate as designed;
- b) The failure of a section of the blast to initiate as designed; or
- c) The failure of whole or partial individual blast holes to initiate as designed.

Misfires may be identified during:-

- a) The firing procedure;
- b) The post firing inspection; or
- c) The mining excavation process.

When a misfire has been identified during the post blast inspection the Blast Controller will regain control of the Blast Exclusion Zone perimeter and the resultant communications.

The Shotfirer will control the mechanics of the misfire and keep the Blast Controller informed in regards to action that result from the misfire.

If a misfire which has been identified during the initial firing sequence, or during the post blast inspection, can be safely refired while the Blast Guards are in position, the suitable notifications and preparations are to be implemented and refiring conducted as soon as possible. However, the Blast Exclusion Zone parameters may have to be extended to a greater distance at the discretion of the Shotfirer.

All instructions issued by the Shotfirer during the refiring of a misfire, must be complied with and confirmed by each Blast Guard. This may include a second safety sweep (clearance) of the Blast Exclusion Zone by the Blast Controller if it is deemed required prior to the refiring of the misfire.

Once the misfire is ready to be refired, the normal firing sequence will commence from the 2-minute warning and Blast Guard checks.



Misfires scheduled to be fired after the initial firing schedule, must follow the firing process as per any normal blasting activity, and include a risk assessment which would include the number and placement of suitable Blast Guards required for the blast.



APPENDIX A: AUSTRALIAN STANDARDS 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.



APPENDIX B: EXAMPLE OF THE BLAST CONTROLLER RADIO COMMUNICATION PROCESS

Timeframe:-		Who makes the radio Call:-	
30 min prior to the firing of the blast		Blast Controller	
'Blast Controller to all stations, there will be a _____ shot at Ramp _____ in approximately 30 minutes'. (Blast Controller to complete a sweep of the Blast Exclusion Zone)			
Timeframe:-		Who makes the radio Call:-	
10 min prior to the firing of the blast		Blast Controller	
'Blast Controller to all stations, there will be a _____ shot at Ramp _____ in approximately 10 minutes'. (Blast Controller to complete a sweep of the Blast Exclusion Zone)			
Timeframe:-		Who makes the radio Call:-	
2 min prior to the firing of the blast		Blast Controller	
'Blast Controller to all stations, can you please maintain radio silence for the firing of the _____ shot at Ramp _____'. (Blast Controller to park up outside the Blast Exclusion Zone) 'Blast guards, can you please confirm that you are in position and your area is secure'.			
Guard Number	Name	Pre-Blast check	Post-Blast Check
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Timeframe:-		Who makes the radio Call:-	
2 min prior to the firing of the blast		Blast Controller	
'Blast Controller to Shotfirer – the blast is now under your control – you are clear to begin the firing sequence – 2 minutes to firing – can you confirm please?'			
Timeframe:-		Who makes the call:-	
2 min prior to the firing of the blast		Shotfirer	
'Shotfirer to Blast Controller – I confirm 2 minute to blast'			
Timeframe:-		Who makes the call:-	
1 min prior to the firing of the blast		Shotfirer	
'Shotfirer to all stations – 1 minute to blast'			



Timeframe:-	Who makes the call:-
25 sec prior to the firing of the blast	Shotfirer
'15 second blast of the siren – wait 3 seconds for any call back from the blast guards'	
Timeframe:-	Who makes the call:-
firing of the blast	Shotfirer
'start countdown – 5, 4, 3, 2, 1 – fire on' Initiate the blast	
Timeframe:-	Who makes the call:-
no definite timeframe after the blast	Shotfirer
'Shotfirer to all stations, the shot has been fired, radio silence is released. Blast Guards please maintain your positions until the all clear has been given'.	
Inspection of the blast area by the Shotfirer	
Timeframe:-	Who makes the Call:-
no definite timeframe after the blast	Blast Controller
'Blast Controller to all stations, the shot has been inspected and appears to be all clear. Blast Guards you may stand down from your position. Can you please confirm that you have received my instruction'	

About the AEISG

The Australian Explosives Industry and Safety Group (AEISG), originally known as the Australian Explosives Manufacturers' Safety Committee, was initially comprised of representatives from Dyno Nobel Asia Pacific Pty Limited (previously Dyno Wesfarmers Limited), Orica Explosives (previously ICI Explosives), Union Explosives Español (UEE, previously ERT), and Total Energy Systems (TES), was formed in 1994. Since then, the AEISG membership has expanded and broadened.

Current (March 2011) membership includes:

- ◆ Applied Explosives Technology
- ◆ Downer EDI- Blasting Services Pty Ltd
- ◆ Dyno Nobel Asia Pacific Pty Limited
- ◆ Johnex Explosives
- ◆ Maxam Australia Pty Ltd
- ◆ Orica Australia Limited
- ◆ Thales Australia