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Invincible Colliery Open Cut

Assessment of Blasting Operations and Overview of Proposed Blasting Program

The following report has been prepared to provide an assessment of the data obtained from previous blasting operations during the operation of Invincible Open Cut from December 1997 to July 2002.

The assessment of the proposed blasting program has been prepared in consultation with representatives from Big Rim Pty. Ltd. and Roche Blasting Services.

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Section 1 Operational Conditions

Whilst operational the previous open cut operations at Invincible incorporated blasting the overburden from above the Lidsdale/Lithgow seam.

Blasting operations occurred whilst the mine was operated by Dukes Earthmoving between December 2000 and September 2001. Prior to this time there was no blasting at Invincible Open Cut.

The EPA licence maintained for Invincible prior to December 2000 did not allow blasting as all o/b was ripped and pushed to allow removal.

When the operations into the extension commenced the licence was modified to allow blasting of overburden prior to removal by excavator and haul trucks.

Whilst blasting was being undertaken the following conditions were applied to the operation and were adopted as the operational criteria to which the blasting was undertaken.

The conditions imposed by the EPA are listed below, taken directly from the conditions of the EPA licence at the time.

> "Blasting in or on the premises must only be carried out between 0900 hours and 1700 hours, Monday to Saturday. Blasting in or on the premises must not take place on Sundays or Public Holidays without the prior approval of the EPA.
>
> The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not:
> (a) exceed 5mm/second for more than 5% of total number of blasts carried out on the premises within the 12 months annual reporting period; and
> (b) exceed 10mm/second at any time
> at any residence or noise sensitive location (such as a school or hospital) that is not owned by the licensee or subject of a private agreement between the owner of the residence or noise sensitive location and the licensee as to an alternative ground vibration level.
>
> The overpressure level from blasting operations carried out on or in the premises must not:
> (a) exceed 115 dB(L) for more than 5% of the total number of blasts carried out on the premises within the 12 months annual reporting period: and
> (b) exceed 120dB(L) at any time
> at any residence or noise sensitive location (such as a school or hospital) that is not owned by the licensee or subject of a private agreement between the owner of the residence or noise sensitive location and the licensee as to an alternative overpressure level."

Following the completion of open cut mining in the area the conditions regarding blasting at Invincible were removed in conjunction with a licence review.

Application will be made to have the appropriate conditions re-instated into the mines current EPA licence.

During the period in which blasting was undertaken at Invincible six shots or blasts were carried out.

Due to the remoteness of the site and its distance from the main road it was not, at the time, deemed necessary to display a sign with shot times and dates at the main entrance of the colliery however notices were given to each of the nearest residences, the adjoining landowner, the EPA and Lithgow Council and within the Cullen Bullen Hotel and General Store providing notice to the community and to all those potentially affected as to the timing of each of the shots.

These notices were circulated on the morning of each shot.

For each shot loggers designed to monitor Ground vibration and blast overpressure were placed at the nearest residences at “Billabong” and at the “Companies Old Cottages” at Cullen Bullen.

At the time the residence at “Hillview” was under construction and monitors were not placed when access was not available.

The results of the monitoring will be discussed in a later section of this report.

The following series of flow diagrams displays the likely process that will be followed to iniate the blasts at the proposed open cut extensions.

Section 2 ***Blast Monitoring Criteria and Operational Objectives***.

Monitoring of Blast Criteria.

Roche Blasting Services (RBS), a division of Roche Mining, carried out the blasting operations at Invincible from their local base of operations at Cullen Valley Mine to the west of Invincible.

The loggers set-out to monitor each of the shots were owned and maintained by RBS.

Of the six shots conducted at Invincible the monitoring devices were triggered by the blast on only one occasion at the nearest residence "Billabong".

On this occasion the ground vibration and blast overpressure were recorded at 1.28 mm/s and 110.2 dBL on the 5th of May 2001 which was shot number 4.

No detectable ground vibration or blast overpressure was recorded as a result of the first, second, third, fifth or sixth blasts carried.

In order to check compliance with consent conditions and to obtain data for shot design and analysis purposes a monitor was set up on colliery land approximately 500 metres distance from shot number 2 in the direction of the nearest residence.

At this test point, referred to as RBS Test Point, a peak particle velocity of 3.20 mm/s was measured with a peak overpressure of 114.1 dBL. (SEE Appendix 3)

No detectable vibration or overpressure was recorded at the other monitoring sites for shot number 2.

It is anticipated that the blasting criteria applied to the previous operations at Invincible will apply to the proposed extension of operations.

Any criteria specified by the DEC in licence or consent conditions will be adopted as the operational criteria to which blasting operations will comply at Invincible.

The flow diagrams attached as Appendix 1 and 2 show the proposed processes to be implemented to establish a production blast schedule and the management and mitigation process associated with the blasting program.

Section 3 ***Review of Blast Monitoring Results.***

As detailed above the monitoring of blasts carried out at Invincible during 2001 revealed that the distance from the nearest residential receptors or residences to the blast is a major attenuation factor when it comes to the impact of blasting at the open cut site.

Of the six blasts held at the mine during this time on only one occasion were the monitoring devices triggered at the nearest residence "Billabong".

On this occasion the ground vibration and blast overpressure were recorded at 1.28 mm/s and 110.2 dBL on the 5th of May 2001 which was shot number 4.

Given the allowable or permissible limits are 10mm/s maximum exceedance and 120dBL maximum exceedence the blast held on the 5th of May 2001 generated ground vibration and blast overpressure well within the allowable criteria.

Environmental Resources Management (ERM), as part of the noise modeling process for the proposed open cut,have used the information provided by Roche Blasting Services and Craven Elliston and Hayes to provide an assessment of blasting impacts from the proposed open cut operation.

ERM stated the following in its assessment of the proposed blasting operations:

The closest location is Billabong (Location 1) at a distance of approximately 1650m.

These distances were then used to calculate potential noise overpressure and ground vibration in accordance with Blastronics published data. Table 3.2 lists these results.

Noise Overpressure and Ground Vibration Predictions

LOCATION	DISTANCE (METRES)	MAXIMUM INSTANTANEOUS CHARGE (MIC), KG	95% OVERPRESSURE, DB	95% GROUND VIBRATION, PPV
Location 1 (Billagong)	1645	242	115	1.9
	1645	897	120	5.0
Location 2 (Hillview)	1770	300	115	2.0
	1770	1037	120	5.0
Location 3 (Cottages)	1968	413	115	2.2
	1968	1282	119	5.0

The results indicate that noise overpressure and ground vibration goals will be achieved if a maximum instantaneous charge (MIC) of 242kg or less is used and the MIC should in no case exceed 897 kg (for the 120dB limit). The MIC needed to achieve the lower limit of 115dB goal for all other locations is in excess of 300kg.

In addition to the published data from Blastronics, site specific data was also available from Roche Blasting services regarding blasts at Invincible Colliery, as listed in Table 3.3.

Site Specific Blast Data provided by Roche Blasting Services

Location	Distance (metres)	Maximum Instantaneous Charge (MIC), kg	95% Overpressure, dB	95% Ground Vibration, PPV
-	500m from blast site	260	114.1	3.2
Billabong	Approximately 1700m from the blast site	450	110.2	1.28

These results indicate that higher MIC values were used for blasts, while still complying with the criteria specified above, at the residence. However, the data set is limited to only two cases, and has therefore not been used for any calculations.

Hence, proper design and consideration must be given to blasting within the area.

Given the above information and applying it to the Maximum Instantaneous Charges calculated for the six blasts held at Invincible (calculated by Roche Blasting Services and displayed in the table below).

Maximum Instantaneous Charge (kg) by Roche Blasting Services.

Shot Number	Date	MIC (kg)
1	25/01/2001	312
2	06/02/2001	260
3	01/03/2001	211
4	05/05/2001	450
5	13/07/2001	570
6	25/07/2001	221

It would appear that shots of similar size and magnitude as used previously at Invincible would be suitable to achieve the desired results within the pit whilst satisfying the appropriate operational Criteria as identified in previous sections.

Section 4 ***Proposed Blasting Program.***

Blasting Overview Prepared by Brett Gray from Big Rim Pty. Ltd.

General

Particular attention shall be applied in all areas of drill and blast from design through to initiation towards minimizing disruption to the environment through reduction of blast overpressure, dust generation and vibration. Big Rim will enter into a subcontract arrangement with Roche Blasting Service (RBS) to carry out our required drill & blast activities at Invincible Open Cut. Such an arrangement will give Big Rim access to the vast amount of technical and operational knowledge, information and expertise available from RBS. This access will ensure that drill & blast operations are carried out in a manner that will:

- minimise environmental impact;
- produce the most efficient and productive blasts possible;
- limit the potential risk to Coalpac Pty.Ltd.;
- minimise coal losses, particularly with interburden blasting.

RBS have considerable experience regarding drill and blast operations in the Western District. They have previously carried out drill and blast operations at:

- Western Main Open Cut;
- Cullen Valley Mine;
- Invincible Open Cut.
- Lamberts Gully Open Cut
- Baal Bone Project

This experience shall be a reference point for all drill and blast planning on site.

Site Preparation

Prior to the commencement of drilling in an area, the drill site shall be leveled off by a bulldozer to obtain a stable base on which the drilling unit will operate. Depending on machinery availability, the area will also be graded as part of the leveling operation. The back wall of the previous shot in the area shall be scaled down and squared up. This shall create a relatively square free face for the next shot and reduce undercutting of the free face. All of these factors are vital to achieving a blast which is safe and efficient. This preparation should minimise the environmental impact of the blast.

Once the area has been leveled, appropriate barriers and signage shall be put in place thereby restricting area access to authorized personnel. The OCE shall be responsible for the preparation and control of this area. When the signage and barriers are in place, a notice shall be placed on the site safety notice boards indicating that laying out and drilling operations will be in progress and that entry to the area is restricted to authorized personnel.

Blast Design and Planning

The design will be based upon:

- Rock type and density;
- Available stemming materials;

- Depth of bench;
- Surface dimensions of bench;
- Loading unit to be used;
- Environmental constraints (overpressure, ground vibration etc).

The Plan shall include:

- Required burdens and spacings;
- Explosive types and relative bulk strengths to be used;
- Blasthole depth and size;
- Blasthole orientation and angles, where required;
- Drill bit size and wear tolerances;
- Monitoring/supervisory activities;
- Initiation system to be used including necessary delays, where applicable;
- Initiation hardware to be used;
- Any operational or environmental constraints;
- Any other information pertinent to the particular blast.

Upon completion of the blast design it shall be documented and distributed to all relevant personnel.

Drilling Operations

These operations shall be carried out strictly in accordance with all criteria set out in the relevant blast plan. All drill operators shall be aware of and operate within all safety, environmental and operational guidelines at all times. The size and wear rate of each individual drill bit and depth and angle of each blasthole shall be monitored and recorded by the Drill Operator. Particular attention shall be paid to the angle of blastholes when this type of drilling is stipulated in the plan.

Shot Charging

Prior to the commencement of charging, all drill holes will be reinspected with respect to:

- conformance to blast plan;
- final wall design;
- position of free face;
- consistent hole sizing and depth;
- orientation of blastholes.

If any blastholes are found to be too shallow, too deep, out of position or there is a requirement for extra holes due to excessive burden, then appropriate corrective actions shall be authorized as soon as practicable.

Charging sheets shall be used on all blasts to record:

- individual hole depths;
- quantities and relative bulk strength of explosives used;
- type of stemming material utilized;
- depth of stemming;
- primers and accessories used.

The tie up of the blast shall be recorded and reviewed to ensure that the maximum instantaneous charge (MIC) criteria is not exceeded.

Blasting Procedures

Prescriptive procedures shall be developed to stipulate:

- minimum proximity of personnel, machinery and equipment to blast;
- minimum proximity of personnel to affected areas;
- dealing with overcharged blastholes;
- placement of guards and warning signs;
- notification of intended blasting and sleeping shots to all personnel;
- communication procedures for firing and all clear signals;
- post blast inspections;
- dealing with misfires;
- liaison with neighbours to give prior notice of blasting activities and monitor the effects of such activities after each blast
- monitoring of all blasts for noise, vibration and performance;
- blasting in close proximity to residential areas.

All drill and blast procedures shall be documented, reviewed and distributed to relevant personnel. Site safety audits will include reviews of all drill and blast procedures relating to safety matters for adequacy and effectiveness. Drill and blast activities and performance will be reviewed on a monthly basis at site management review meetings.

Proposed Explosives and Initiation Methods

RBS propose to use reduced density explosives for the Overburden blasting on site. Such explosives will provide a number of beneifts for the project including:

- Reduction in environmental impact;
- Cost efficiencies;
- Minimized coal losses through blasting.

The IB will require the use of increased density explosives for the most cost effective result. Both of these types of bulk explosive have been used to good effect in this district previously. RBS will work closely with Big Rim to ensure the most efficient combinations of explosives are used throughout the project.

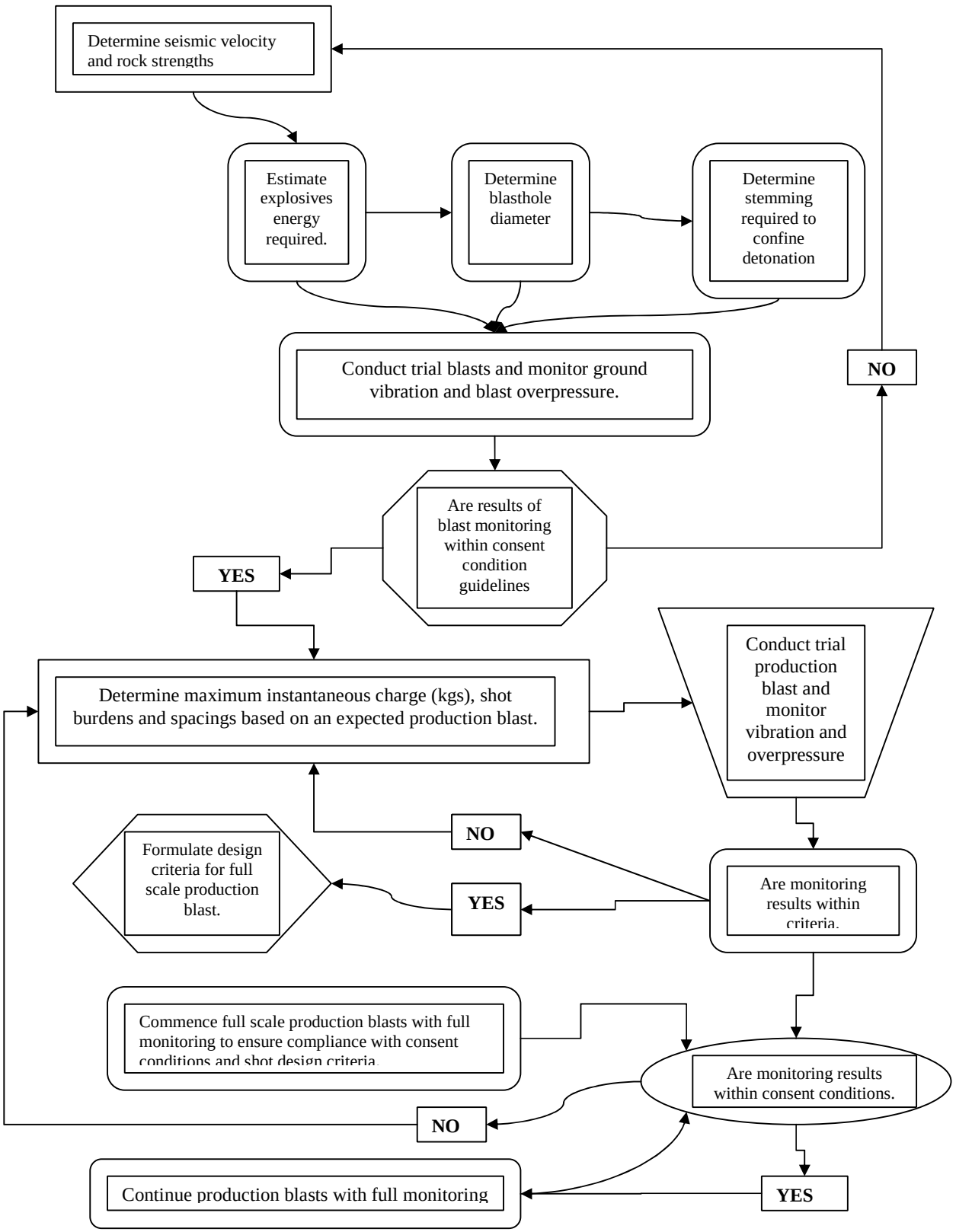
It is proposed that NONEL initiation systems will be used. While RBS have access to, and are experienced in the use of, electronic initiation systems, it is considered that there would be no palpable advantage in the use of such a system. If monitoring of blasts indicates that there may be a performance advantage by the use of such systems, then RBS have the capability to use electronics for subsequent shots.

For the initial blasts, a conservative approach will be adopted in Maximum Instantaneous Charge (MIC), Powder factor (PF), explosive density and pattern design. Consultation between all involved will allow subsequent blasts to be adjusted to deliver the best possible results for all blasting activities.

Appendix 1 .

Program for Establishing Production Blasts at Invincible Open Cut

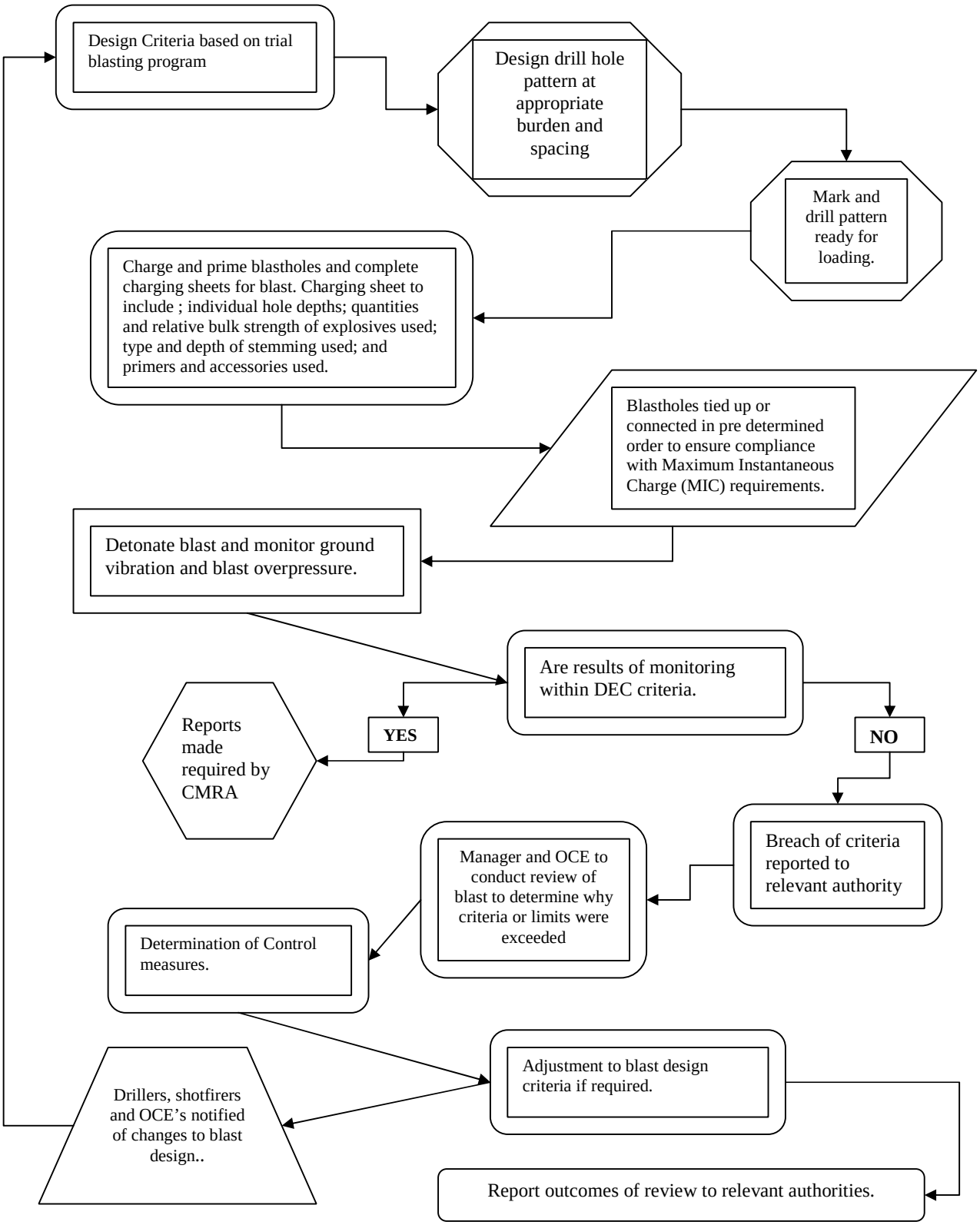
Program for Establishing Production Blasts at Invincible Open Cut



Appendix 2

Mitigation and Management Measures to Control Impacts of Blasting Program At Invincible Open Cut

Mitigation and Management Measures to Control Impacts of Blasting Program At Invincible Open Cut



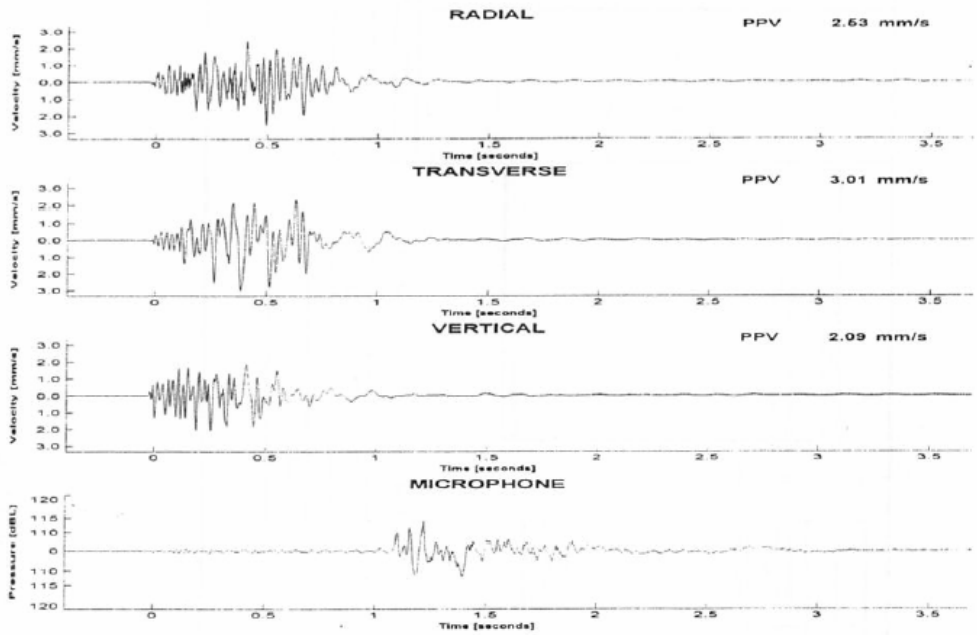
Appendix 3
Additional shot information for Invincible Open Cut Previous Shots Supplied by Roche Blasting Services

Roche
BLASTING SERVICES

Invincible Mine

Time: **15:12:34**
Date: **06 Feb 2001**

Monitor Location: **RBS test point**
Blast No/Id: **INV02**



BLAST SUMMARY

Pattern Type	:	**Square**	Max. Inst. Charge :	.
Pattern Size (m)	:	**6 x 8**	Explosive (Type & Weight)	
Designed Tonnage	:	**14,630kg**	a) **SoftLOAD at 0.4 density**	
Bench Height (m)	:	**14.5m**	b) .	
Number of Rows	:	**5**	c) .	
Number of Holes	:	**80**	Delay Type -	**Nonel**
Blasthole Dia. (mm)	:	**203 mm**	- Average Interval (ms):	**17 & 42ms**
Stemming (m)	:	**3.5 mtrs**	- Duration (ms) :	.
Sub Drill	:	**0.0 mtrs**		

Peak Vector Sum Velocity : 3.20 mm/s

Peak Overpressure : 114.1 dBL

Comments & Observations

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Monitoring conducted by: **Alan Fritz** **(:for Roche Blasting Service)**

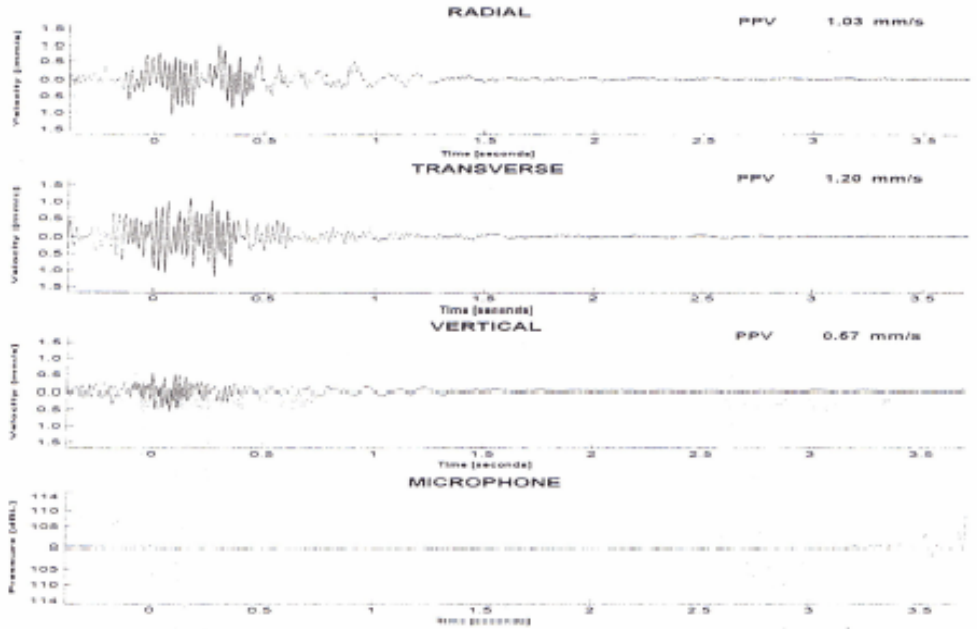
µMX Serial Number: **0557** Last Calibration: **14 Sep 2000**

EL:2.0 Templates\Invincible_203mm.rtt shots\Invincible\Invincible 2001-02-06 15.12.34 - 1.qwf

Roche
BLASTING SERVICES

Invincible Mine

Time: 14:15:02
Date: 05 May 2001
Monitor Location: Station 1
Blast No/Id: INV 04



BLAST SUMMARY

Pattern Type	: **Square**	Max. Inst. Charge :	**kgs**
Pattern Size (m)	: **6 x 8 mtrs**	Explosive (Type & Weight)	
Designed Tonnage	: **18,963kgs**	a) **SoftLOAD at 0.4 density**	
Bench Height (m)	: **15mtrs**	b) **ANFO at 0.8 density**	
Number of Rows	: **15**	c) .	
Number of Holes	: **103**	Delay Type - **Nonel**	
Blasthole Dia. (mm)	: **200 mm**	- Average Interval (ms):	**17ms**
Stemming (m)	: **3.0 mtrs**	- Duration (ms) :	**917ms**
Sub Drill	: **0.0 mtrs**		

Peak Vector Sum Velocity : 1.28 mm/s

Peak Overpressure : 110.2 dBL

Comments & Observations
Some venting experienced from old underground workings.
Prior wet weather caused some delays with loading.
Generally good result achieved.

Monitoring conducted by: **Jim Drane** **(for Roche Blasting Services)**

µMX Serial Number: **0557** Last Calibration: **14 Sep 2000**

EL:2.0 Templates\Invincible OverBurden 203mm.rtt Invincible\Monitors\Invincible Shot04_ 2001-05-05 14.15.02 - 1.doc