



# UNDERGROUND

## BULK EXPLOSIVES

[AECIMINING.COM](http://AECIMINING.COM)

 **AECI**<sup>®</sup>  
**MINING EXPLOSIVES**



# CONTENTS

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## GLOSSARY OF ABBREVIATIONS

<b>PCU</b>	Portable charging unit
<b>MCU</b>	Mobile charging unit
<b>BCU</b>	Blast control unit
<b>CBS</b>	Centralised blasting system
<b>DS</b>	Digishot®
<b>DS+</b>	Digishot® Plus

<b>IS</b>	Initiating systems
<b>PEX</b>	Packaged explosives
<b>LP</b>	Long period
<b>LPD</b>	Long period delay
<b>SPD</b>	Short period delay



# INTRODUCTION

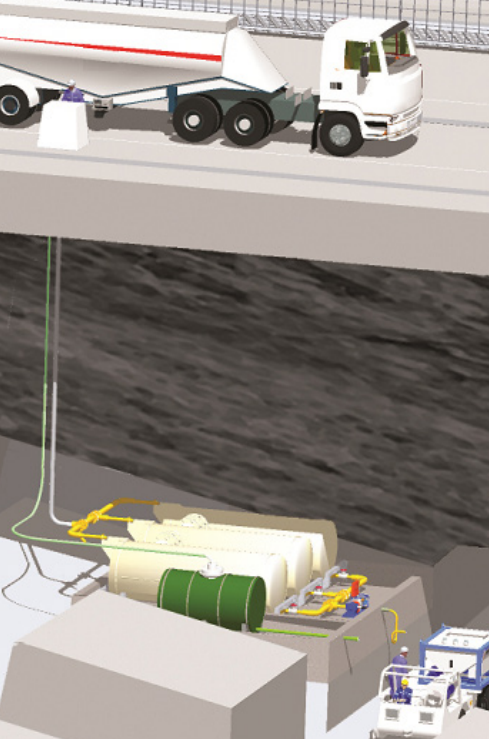
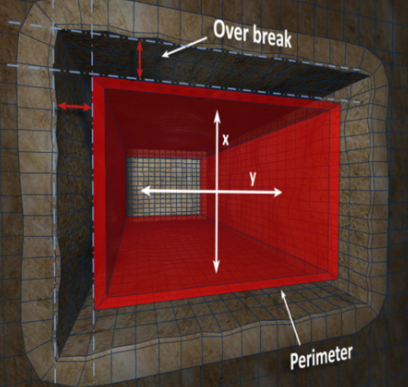
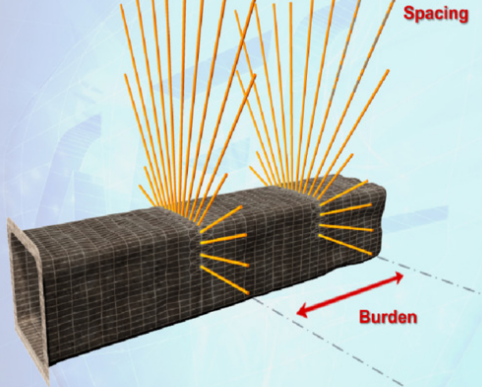
**Delivering smart systems and solutions for the underground mining industry is part of AECI Mining’s integrated offering. Inherently engineered into its delivery systems is state-of-the-art technology that enables miners to be more efficient.**

Underground Bulk Systems (UBS) offers holistic solutions that enables improved blasting outcomes, blasting efficiencies and cost containment. Unique UBS characteristic offerings:

- It allows transportation and loading of emulsion in a non-explosive state
- We developed unique technology that enables emulsion to “stick” in vertical upholes
- The Company’s underground emulsions are compatible with all our initiating systems
- Paired with the centralised blasting system, BlastWeb®, safety pertaining to blasting operations can be further enhanced
- Full coupling of the emulsion in the blast hole column, in conjunction with energetic formulations, deliver superior blast outcomes
- These improved blast outcomes inevitably enhance overall mining efficiency, leading to reduced operational cost

The complete system underpinned by our underground bulk value proposition significantly improves efficiency, which leads to reduced face time. Naturally, this culminates into a safer working environment by limiting worker’s exposure to potential hazards.

# UNDERGROUND BULK EMULSION

PUMPABLE EMULSION	STANDARD	STICKY
		
	<p>Standard emulsion is used in typical underground mining applications, i.e. development, stoping. The emulsion is cap-sensitive and suitable for most underground mining conditions. It's ability to vary energy output at the face allows for specific blasting outcomes in a variety of applications.</p>	<p>This unique formulation, often referred to as sticky emulsion, was specifically developed for niche applications, i.e. Vertical Crater Retreat (VCR) stoping, Longwall stoping, Caving methods: Sub-level caving (SLC), Block caving, etc. as it has the ability to remain in vertically drilled blast-holes. It is also successfully applied in development and perimeter control applications.</p>
<b>Minimum Hole Diameter (mm)</b>	25	45
<b>Water Resistance</b>	Excellent	Excellent
<b>VOD (m/s)</b>	4000 - 5500	4000 - 5500
<b>Sensitised product Density (g/cm<sup>3</sup>)</b>	1.00 - 1.18	0.7 - 1.18
<b>Pumping Stages</b>	6	4
<b>**RWS @ 100Mpa</b>	88-102	59 - 92
<b>**RBS @ 100Mpa</b>	110-152	52 - 138

# UNDERGROUND BULK EMULSION

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Emulsion formulations are continuously being evolved to suit modern mining methods. Each formulation is engineered to deliver differentiated blasting outcomes through adjustable energy.



## TECHNICAL SPECIFICATIONS

### CLASSIFICATION

Underground base emulsions comprise of an oxidiser and fuel blend. It is classified as a non-explosive. A sensitiser needs to be added during the charging process to render the emulsion an explosive.

Portable charging units (PCU) are used in conjunction with pre-packed bagged emulsion and bottled sensitiser. This allows the customer to enjoy the advantages of an emulsion explosive even though you are limited to the current infrastructure of a conventional mine.

### APPEARANCE

The aqueous sensitiser comes in a variety of colours. It is particularly useful to assist the operator in verifying that the emulsion contains sensitiser as it changes the colour of the emulsion. The colourants are added for easy identification of targeted density ranges.

### BENEFITS

- Improved safety
- Ease of use
- Faster charging time
- Less labour intensive
- Improved Fragmentation
- Simplified logistics
- Better management and control
- Environmentally friendly
- Minimal capital for the pumps
- Minimal infrastructure required to ensure control as per legislation

### FEATURES

- Only detonable after sensitisation
- Variable densities
- High VOD
- Water resistance
- Non-soluble
- Low fume emissions
- Various packaging options
- Reduced underground/face exposure



# DELIVERY SYSTEMS

## UNDERGROUND BULK EMULSION

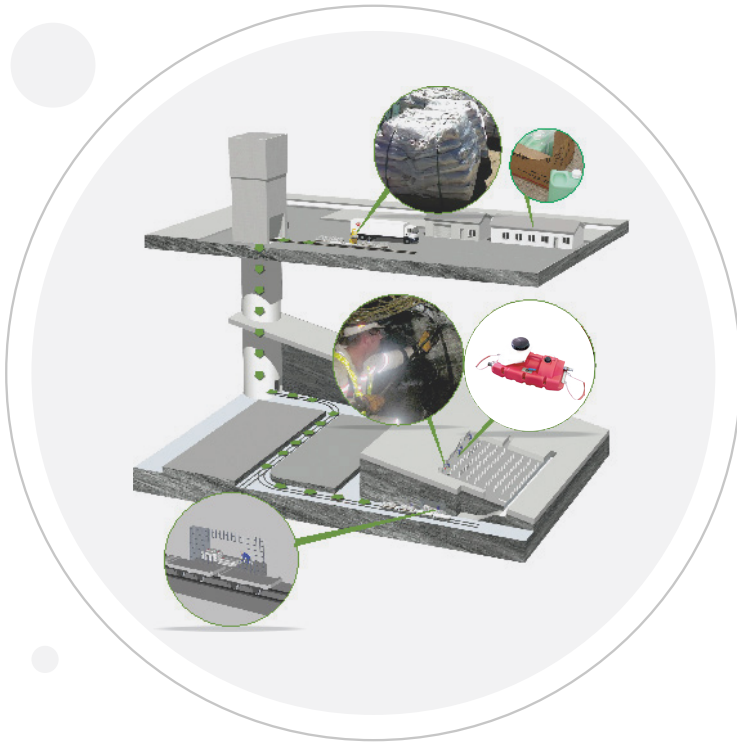
### **Continuously evolving towards safer ways of blasting.**

AECI Mining, an international leader and innovator in commercial explosives and blasting solutions, employs a range of delivery systems in both Narrow reef and trackless mining operations to afford users a flexible logistical solution for their explosives requirements.

All systems are developed taking into consideration the requirements of a highly regulated mining industry and with safety as its key priority. Emulsion-based products are not classified as an explosive until sensitised and pumped into the blast-hole. It offers a high level of security and control, which has not been possible with conventional systems.

# BAGGED SYSTEMS

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## APPLICATION

Conventional Narrow reef mining at any depth.

## DESCRIPTION

Emulsion is packaged in 25kg polywoven bags (2 x 12.5kg), taking into account human ergonomics. This packaging arrangement greatly improves stock control and mobility. Bagged emulsion can be stored on surface and/or underground workings. When required, it is transported to underground workings in standard material cars. Although it is classified as a non-explosive, limited quantities are allowed be stored adjacent to workings. Emulsion is delivered into blast-holes with our portable charging units (PCU).

# HYBRID SYSTEMS

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## APPLICATION

Conventional Narrow reef and trackless mines.

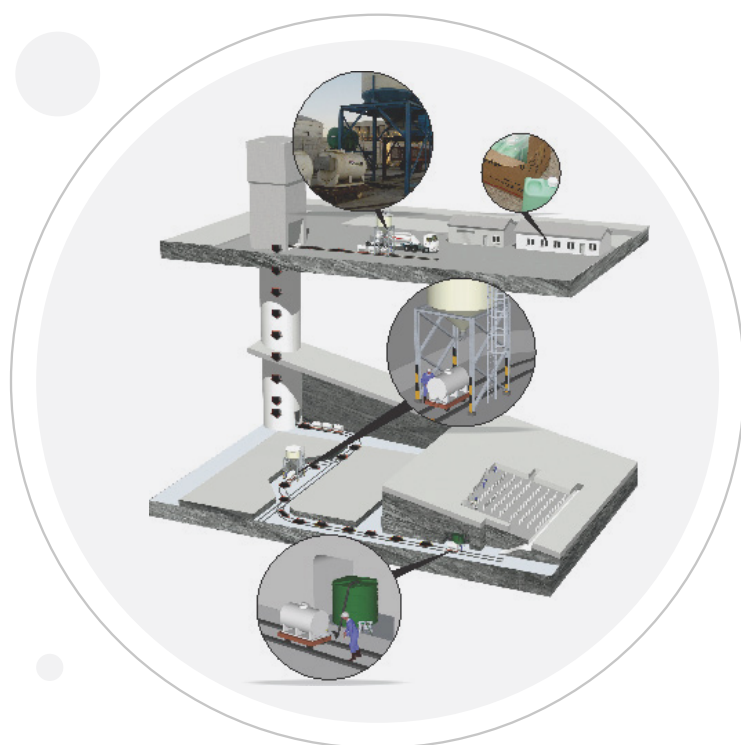
## DESCRIPTION

Underground mines, up to a certain depth, have the option of bulk emulsion deliveries by means of the Vertical Drop delivery system. The Vertical Drop can be conducted from surface or from a dedicated underground distribution point to a centralised storage area where MCU's are refilled.



## BULK SYSTEMS

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### APPLICATION

Conventional or trackless mining at any depth.

### DESCRIPTION

Bulk emulsion is delivered to the surface silo(s). MCU's are either filled from these silos on surface or alternatively, emulsion cassettes are deployed for filling MCU's underground. Cassettes are rotated and re-filled from surface silos as dictated by production demand.

# VERTICAL DROP EMULSION DELIVERY SYSTEM

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## LEADING INNOVATION IN VERTICAL DROP TECHNOLOGY

### What is a vertical drop delivery system?

It is a bulk emulsion delivery system where emulsion is transferred from surface through a borehole system into the underground workings. The infrastructure involves a sophisticated control system to safely transfer product from surface directly to underground storage facilities. Storage facilities typically include silos, which are digitally regulated from a central vantage point.

### How does this solution assist the customer?

Emulsion technology eliminates the constraints of explosive deliveries imposed by legislation. Our vertical drop system has the potential to significantly streamline shaft delivery times and tramming schedules. The fact that storage facilities are in close proximity to the underground production areas, dramatically improves efficiencies by reducing travelling and turnaround time. The main objective of this innovation is to improve safety during tramming, enabling miners with better management of explosives and simplify compliance to the regulations.

### Rationalised product range

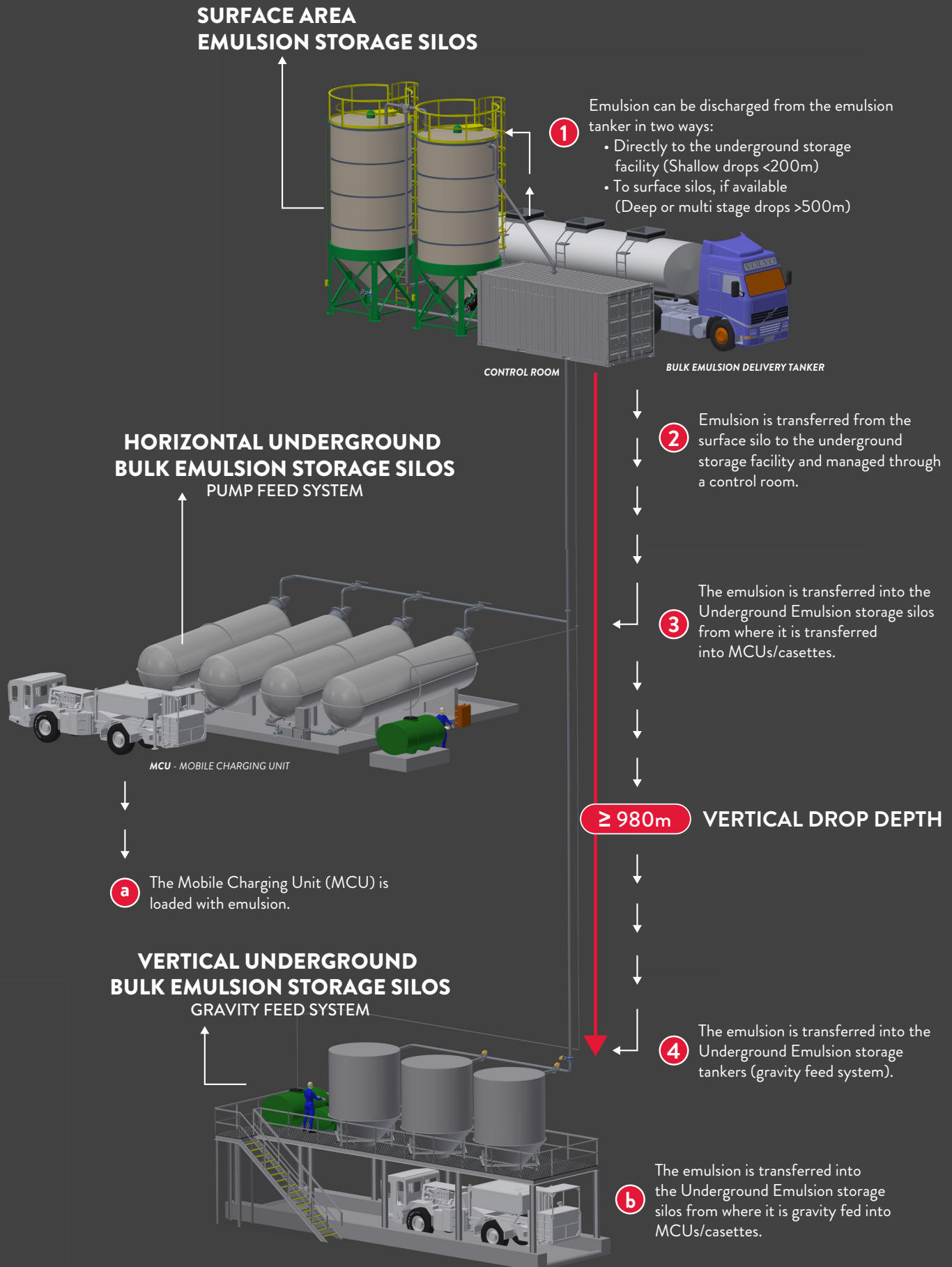
Various diameters and lengths of cartridges are replaced with a singular non-explosive product, impacting positively on stock-holding and control.

### Reduced license circle

The classification of emulsions (5.1 oxidiser) vs. conventional explosives (1.1D explosive) has a significant impact on licensing circle sizes.

## FIT-FOR-PURPOSE INNOVATION

# VERTICAL DROP SYSTEM PROCESS





# APPLICATION & EQUIPMENT

**We supply original equipment and aftermarket parts to customers worldwide.**

The Equipment Services Division has the capacity to erect and commission a complete emulsion plant at any “green fields” site globally. With local and international level access, the team is renowned for technical support, training and overall after-sales service.

We understand that our customers work in environments that leave no room for error and that they can’t afford to speculate on the consistency and safety of their equipment. It is for this reason that we are proud of our long-standing relationships with world-class manufacturers and our impressive buying power to deliver our customers the best possible lead times on deliverables and pricing.

# APPLICATION

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## TUNNELLING & LARGE EXCAVATIONS

AECI Mining has vast experience in all methods of underground mining, most notably, tunneling, bord-and-pillar as well as other massive mining methods, i.e. VCR. Additionally, the company has been involved in major civil blasting projects such as underground public transport infrastructure in Hong Kong and South Africa. We continue to develop explosives and delivery systems to meet modern mining demands. An example is our 'cap-sensitive' formulations making it a global leader in this field.



## NARROW TABULAR ORE BODIES

AECI Mining pioneered the introduction of bulk emulsion in the underground mining environment, employing a selection of innovative delivery systems suitable for confined spaces. We continue to invest in research and development to progress its value proposition.



## RING BLASTING

AECI Mining is the undisputed world leader in manufacturing bulk emulsions that have the ability to stick in vertically drilled blast-holes after charging. We have successfully charged vertical blast-holes up to 102mm in diameter in various underground conditions. The company has a fit-for-purpose delivery system, which has been specifically developed for remote up-hole charging.



# EQUIPMENT

## CAPABILITY DRIVEN BY VERSATILITY

The company provides a full range of Mobile Charging Units (MCU's), catering for all underground mining applications. MCU's are capable of pumping the full range of our bulk explosives products from development end to vertical holes.

All MCU's are designed to operate in the demanding environments encountered during normal mining operations. Design parameters include all necessary safety control systems, as well as ease of operation, maintenance and reliability. Spares are readily available for all MCU's. Units are of a modular design and are able to be mounted on all utility vehicles supplied or preferred by the customer. Custom designed equipment is available on request.



**MCU 1,5T/2T/4T**  
Hydraulic or electric machines used in development.



**MCU 0.75 LC**  
Used in trackless development with faces typically less than 25m<sup>2</sup>.



**MCU 1,5T/2T/4T**  
Hydraulic or electric machines used in conjunction with utility vehicles equipped with a basket are ideal in large development faces (>25m<sup>2</sup>).



**MCU 1,5T**  
Hydraulic or electric machines used in conjunction with Manitou or CAT forklifts used in development.

# EQUIPMENT

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Jumbo MCU's are designed for massive mining applications and can be used for both vertical and horizontal charging applications. Custom modifications include the potential to do development and perimeter charging as well.

## BENEFITS

- Remote charging of rings to enhance safety
- Hose pusher reduces the labour requirement to do up-hole charging
- Speed of charging accelerated by means of application of hose pusher
- Controlled extraction rate of hose ensures full coupling in hole
- Accurate mass of product placed in each blasthole optimizing explosive efficiency
- Tank size optimized to match requirements
- All parameters controlled by PLC

# EQUIPMENT

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## PORTABLE CHARGING UNITS (PCU)

To deliver the underground emulsions, AECI Mining have pioneered the development of portable charging units for use in Narrow reef conventional mines for over a decade and have successfully converted a number of mines to-date. The first major leap forward in this technology was the PCU010 Pump launched in 2012.

The PCU010 Pump represents a World First for a modular pump for Narrow reef charging. It's versatile design allows it to remain in the workings of the mine even during maintenance, **making it every miner's best friend.**

### BENEFITS

- Cost-effective charging with emulsion versus Packaged explosives
- All the benefits of charging with emulsion available in Narrow reef mining
- Reduced charging times
- Easier adherence to explosive legislation
- Fixed mass/stroke to control wastage and explosive control
- Robust equipment requiring minimal maintenance at minimal cost
- Flexible density ranges to adapt to ground conditions



## PCU011 PUMP

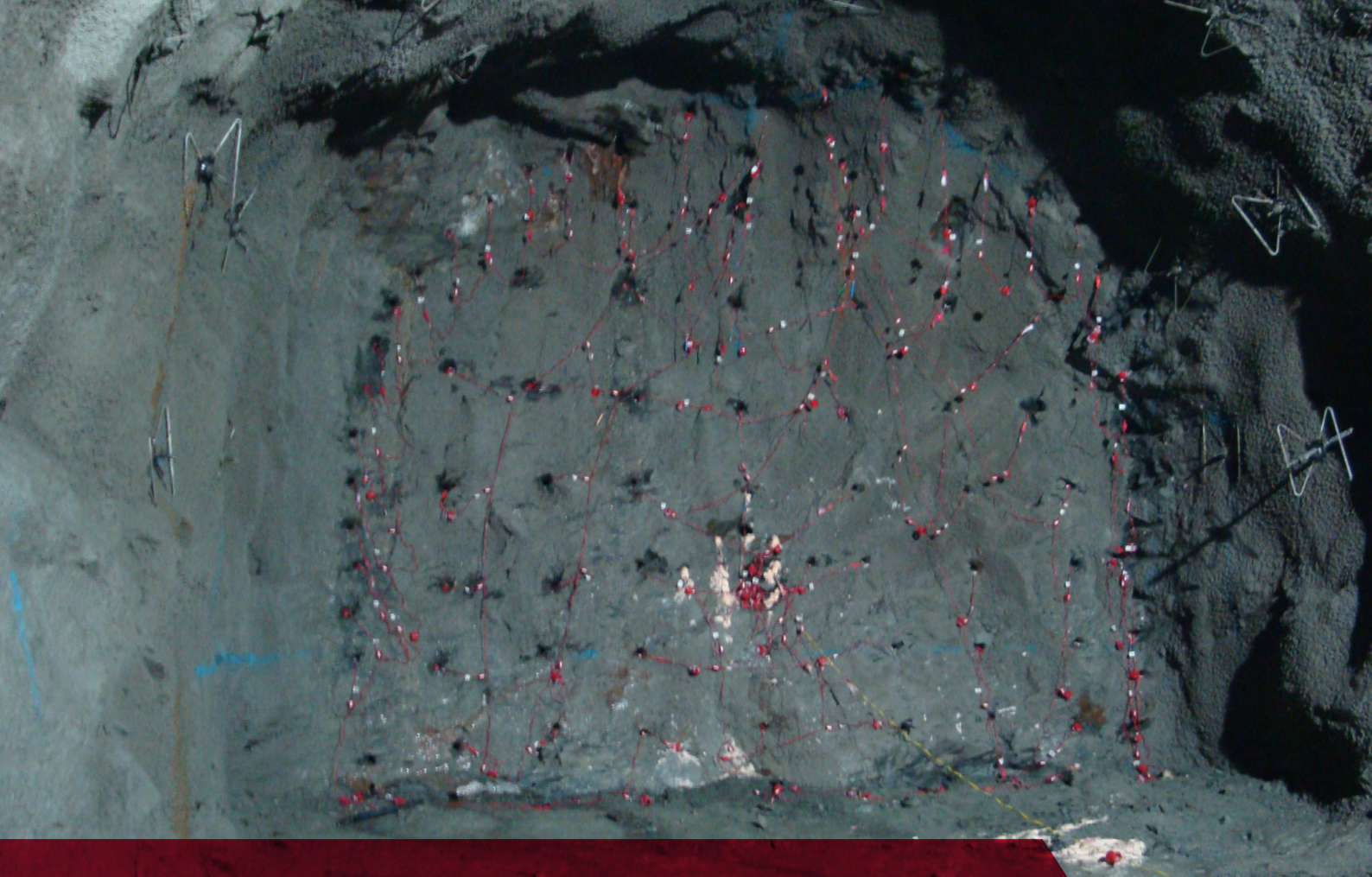
AECI Mining recognised the requirement for a lighter pump to be even more maneuverable in the narrow workings of conventional mining excavations and the need to minimize the labour involved with charging, and to address these requirements have recently launched the PCU011 Pump.

### BENEFITS

**Over and above the benefits accredited to the PCU010 the PCU011 has the following unique benefits, namely;**

- Light, robust and easily transportable
- The PCU010 and PCU011 are available in both pneumatic and hydro power





# INITIATING SYSTEMS

**Our experience has enabled us to perfect robust electronic initiation solutions with superior blasting performance, complimenting the Zero Harm philosophy, with safety inherent in the system design.**

AECI Mining, an international leader and innovator in commercial explosives and blasting solutions, employs a range of delivery systems in both Narrow reef and trackless mining operations to afford users a flexible logistical solution for their explosives requirements.

All systems are developed taking into consideration the requirements of a highly regulated mining industry and with safety as its key priority. Emulsion-based products are not classified as an explosive until sensitised and pumped into the blast-hole. It offers a high level of security and control, which has not been possible with conventional systems.

AECI Mining's electronic detonators are highly resistant to accidental initiation from static, stray currents, induced current, and over voltage from lightning. Robust electronic and shell design provides high resistance to dynamic shock desensitisation and EMP. These attributes make them suitable for use in the toughest tunneling, shaft-sinking and underground stoping mining environments.

# INITIATING SYSTEMS USED IN CONJUNCTION WITH UNDERGROUND EMULSION

## MULTI LPD

A Multi LPD (long period delay) is a non-electric initiation system which is designed for use in underground mines in conjunction with emulsion.

The unit contains an in-hole long period delay detonator. At the free end of the shock tube is a colour coded connector clip indicating the delay period. 23 different long period delays are available to accommodate the most complex blast designs. The connector clip connects the assembly to detonating cord.

### APPLICATIONS

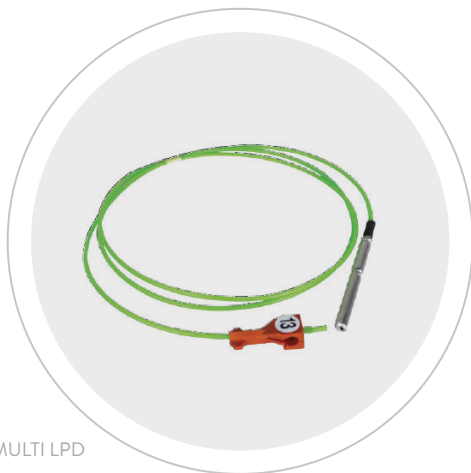
Tunnelling and stoping in the massive mining environment.

## MULTI SPD

A Multi SPD (short period delay) is a non-electric initiation system which is designed for use in underground mines in conjunction with emulsion. The unit contains an in-hole delay detonator, shocktube and a connector clip connected to detonating cord.

### APPLICATIONS

In conjunction with underground emulsion Multi SPD are used extensively in ring blasting in conjunction with detonating cord.



ELECTRIC SHOCKTUBE STARTER



# INITIATING SYSTEMS USED IN CONJUNCTION WITH UNDERGROUND EMULSION

AECI Mining, in conjunction with high-tech electronic initiating system developers, DetNet, have pioneered and spearheaded the development and production of electronic detonators since the early 1990s.

To adapt with the mining industry's varied mining environments, our electronic detonator systems are extremely diverse, making them ideal to use in the simplest and the toughest situations. From tunnelling and shaft sinking, to underground Narrow reef stoping, bord and pillar and other massive mine stoping applications.

From a BlastWeb® terminator, up to 200 detonators per channel can be fired. The detonators are typically DigiShot® or DigiShot® Plus or a NetShock® where only a Electronic starter is required.

## BENEFITS

- Easy-to-use
- Minimal components to simplify use
- Automatic or programmable delay timing
- Fully functional testing and self diagnostic

## FEATURES

- Rugged reliability
- Protected against stray currents
- Designed to be initiated by firing equipment specifically designed for the DigiShot® Plus system
- Remote firing capability
- Multiple blast capability
- Synchronisation capability
- Password protected which prevent initiation with any other electrical source

## MINING METHOD

Underground: Massive

## APPLICATIONS

Tunnelling; Massive (uphole); Ring Blasting

## CERTIFICATION / APPROVALS

- ISO 9001
- Explosives Authorization / Permit - ZA-X 381A
- Product shelf life - 36 Months

## TRANSPORT (UN CLASSIFICATION)

Class 1.1B, UN No. 0030, Product Group 2, DETONATORS, ELECTRIC

Class 1.4S, UN No 0456, Product Group 2, DETONATORS, ELECTRIC



# INITIATING SYSTEMS USED IN CONJUNCTION WITH UNDERGROUND EMULSION

## DIGISHOT®

DigiShot® now provides portability for users that wish to have the flexibility in their blasting operation. The DigiShot® system is able to fire starter detonators with full electronic detonators simultaneously for different initiation methods

Examples include environmentally sensitive operations such as tunnelling close to surface and buildings where minimising vibration is a key concern and single hole firing is essential.

In addition, large underground blasting in the form of multiple rings in ring and bench blasting and shaft sinking make use of emulsion in conjunction with electronics.

### BENEFITS

- Easy-to-use
- Minimal components simplifying use
- Automatic or programmable delay timing
- Full functionality testing

## NETSHOCK®

NetShock® has been developed to be used exclusively with DigiShot® and BlastWeb® to initiate Shock Tube blast design requirements. The Netshock® replaces the use of electric starters with the advantage of a controlled electronic starter.

An aluminium tube which contains an electronic detonator assembly with an integrally moulded clip allowing easy connection to shock tubes.

### BENEFITS

- Conveys real time in-stope intelligence and reports to the central management workstation
- Safety benefits of NetShock® initiators include protection to over voltages, electrostatic discharge and unauthorised use as the detonator requires a specific coded signal to fire



# INITIATING SYSTEMS USED IN CONJUNCTION WITH UNDERGROUND EMULSION

## INTRODUCTION

With a long history and proven track record, AECI Mining is strategically positioned to offer a range of products and solutions to complement the underground emulsion applications. Our initiating systems and components are highly adaptable, designed with the user in mind and are available as “Standard” and/or “Made-To-Order”.

The suite of initiating systems associated with underground emulsions includes nonelectric in different delays and lengths (shock tube) and electronic detonators, as well as a comprehensive range of boosters, detonating cords and starters.

This marketing pack focuses specifically on the following products which are used in conjunction with underground emulsions, namely;

- Non-electric
- Electronics
- Blastweb

## NON-ELECTRIC

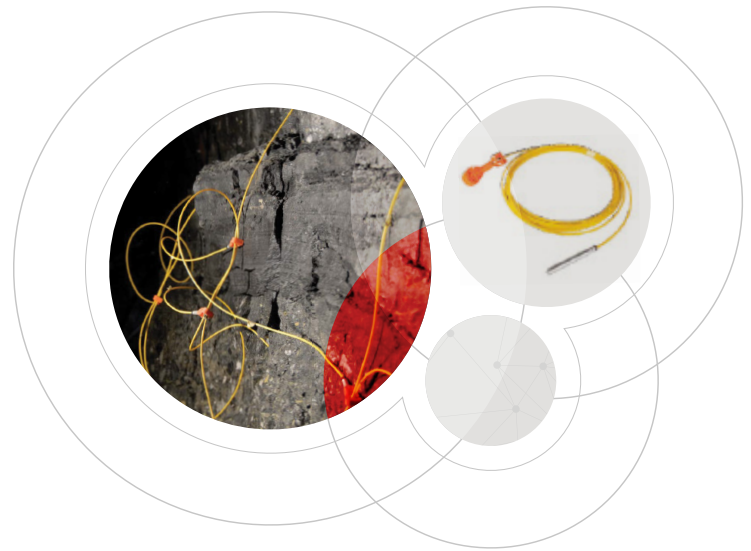
AECI Mining offers its customers in underground mining a full range of non-electric shock tube initiating products to use in conjunction with underground emulsions.

### BENEFITS

- Units easily identified in dark environments to enhance safety
- Quick and simple to connect saving time and labour

For simplicity, the key products used in conjunction with underground emulsion will be identified as well as the application in which they are used.

Different timing techniques are used to suit customer requirements.



## UNI-DELAY LP

A Uni-Delay LP (long period) is a non-electric initiation system which is designed for use in underground mines in conjunction with emulsion.

The unit consists of both out-hole and an in-hole delay detonator. Assembled with brilliant yellow shock tube, the latter for the Vivid product series where improved visibility characteristics are required. The Vivid series is assembled with neon orange connectors to maximise product visibility in the dark, dusty and muddy underground conditions.

### APPLICATIONS

In conjunction with underground emulsion Uni-delay LP are used extensively in Narrow reef stoping and development and trackless bord & pillar mining as well as tunnelling.

# INITIATING SYSTEMS USED IN CONJUNCTION WITH UNDERGROUND EMULSION BLASTWEB®

## ELECTRONIC CENTRALISED BLASTING SYSTEM

The BlastWeb® electronic initiation system is designed for underground environments where there is a requirement for ease-of-use, limited user interaction and centralised blasting. The BlastWeb® system is capable of initiating specific electronic detonators or to initiate underground shock tube rounds. The system is deployed internationally with a solid performance track record.



## TECHNICAL SPECIFICATIONS

### BENEFITS

- Pre-blast diagnosis and communication of potential safety hazards and production challenges
- The scale, location and extent of the planned blasts are known before panels are centrally initiated from surface
- The lost blast rate is significantly reduced using this system thereby minimising production losses
- The unit is fully operational during power failures

### FEATURES

- Provides pre- and post-blast diagnostics
- Includes an on-board diagnostic system for safe testing
- Timing offset between sections can be introduced for mining areas that require reduced seismicity
- The use of high security blast keys and passwords ensure that total blast safety is always under the control of the responsible person

## CERTIFICATION / APPROVALS

- Certificate of approval M-XPL/08326
- ISO 9001
- Explosives Authorisation / Permit - ZA-X 213A

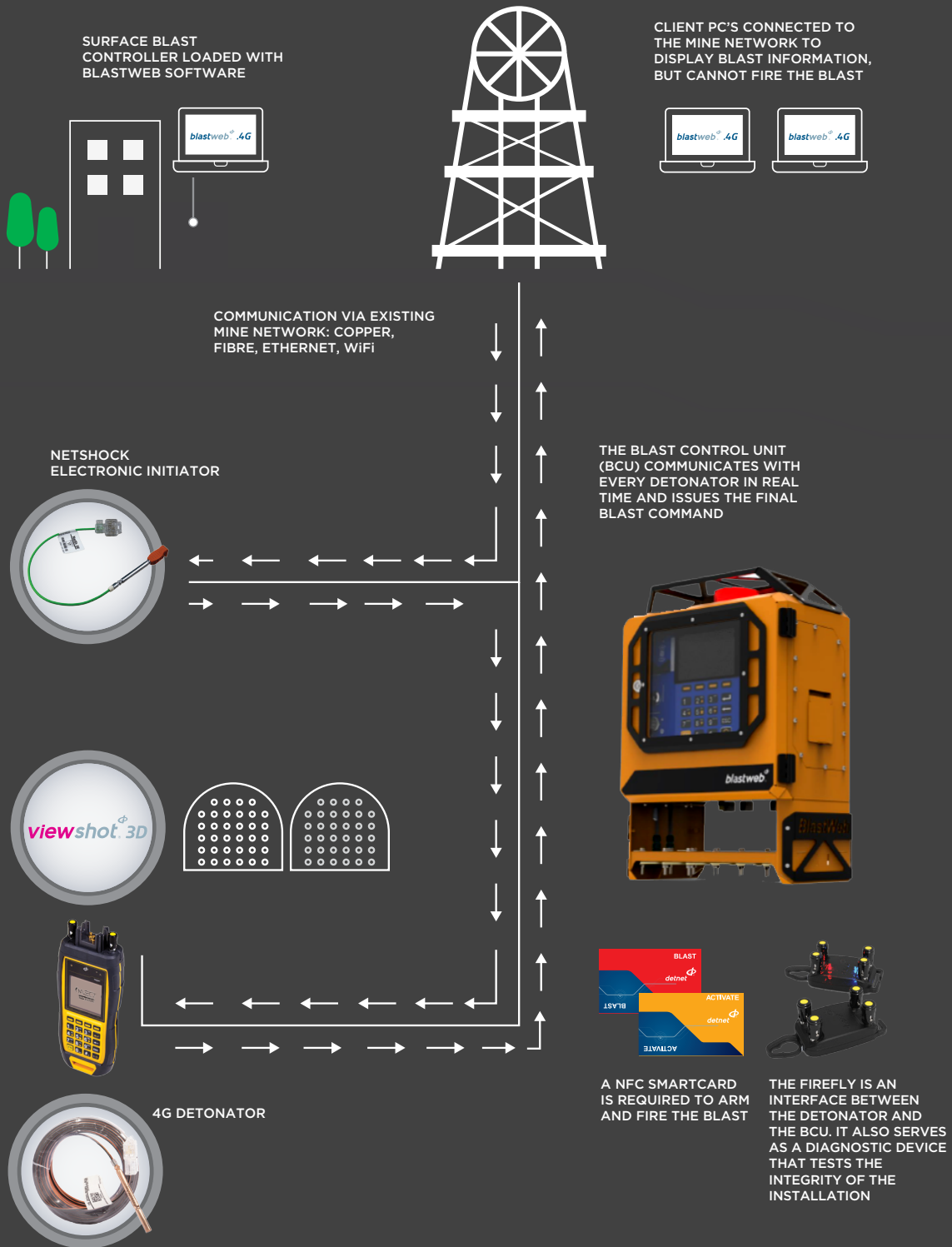
## TECHNICAL PROPERTIES

Programmability	Semi-programmable
Firing Method	Network infrastructure
Timing; Delay Assignment	From central position
Water Resistance	Excellent
Shaft Network	Copper, Fibre, Leaky Feeder, Wi-Fi, PED
Surface Network	Ethernet or LAN
Face Network	Copper (Biphase Space), 1.8mm <sup>2</sup> , 6 independent phases

## BLASTER TECHNICAL INFORMATION

Maximum firing cable – from 1 <sup>st</sup> detonator to blasting point	1000m 3000ft
Access to blast history or blast logs	✓
Blast locally or centrally from surface	✓
Battery backup to blast in power failure situations	✓
Incorporated relays to enable control of external systems (Air, water, electricity)	✓

# BLASTWEB® DEPLOYMENT



# SUMMARISED BENEFITS

## USING UNDERGROUND BULK EMULSION

The general application of underground bulk emulsion, making use of the Bulk, Bagged and Hybrid delivery systems, with their respective equipment, further reduce pollution of mine water and the overbreak of mine arteries enhancing safety and environment.



# PRODUCT AND APPLICATION

MINING METHOD	PRODUCT NAME				
	Emulsion	Initiating Systems Non electric	Initiating Systems Electronics	Mobile Charging Unit	Portable Charging Unit
Tunnelling & development	✓	✓	✓	✓	x
Small inclined development	✓	✓	✓	x	✓
Narrow reef stoping	✓	✓	✓	x	✓
Sub-level open stoping	✓	✓	✓	✓	x
Long-hole stoping	✓	✓	✓	✓	x
Cut and fill	✓	✓	✓	✓	x
Bord & pillar	✓	✓	✓	✓	x
Room & pillar	✓	✓	✓	✓	x
Vertical crater retreat	✓	✓	✓	✓	x
Shaft sinking	✓	✓	✓	✓	✓

# SUSTAINABLE BLASTING



## 100 MILLION TREES

### *Eco-friendly explosives, for greener blasting.*

In just a little more than a decade since the introduction of used oils into its various Eco bulk emulsion formulations, AECI Mining Explosives has consumed more than 80 000 000 liters of used oil. This initiative has prevented approximately 55 000 tons CO<sub>2</sub>e into the atmosphere, which equates to having to plant roughly 100 million trees. Thank you for partnering with us in our quest to drive more sustainable blasting.





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