SOFTWARE BLASTING TOOLS INTEGRATED WITH ELECTRONIC INITIATION SYSTEMS

by

M. Thierry BERNARD

M. Jean Marc LABOZ

Delta Caps International (D.C.I.)

B.A.I. COURSE

ORLANDO

JULY 2000

ABSTRACT : This paper explains why and how integration of EIS (Electronic Initiation System) with dedicated software tools can increase benefits to blasters and at the same time simplify the design of blast sequence

1. INTRODUCTION

Nowadays Electronic Initiation Systems (EIS) are available to the mining industry. They are industrially produced and used daily by a everyday larger number of blasters.

EIS can be used to solve many different mining problems.

At first they are more accurate than standard initiation systems. This constitutes already a key advantage that can bring benefits to the users.

However we believe that users could benefit of the full flexibility of EIS bringing additional benefits if EIS are used in a different way than what is being done with standard initiation systems.

The goal of this paper is to describe the potential of integrating dedicated software tools together with Electronic initiation devices.

We will first give a short description of DSL2, the electronic initiation system from DCI.

Secondly we will review the requirements of what should be a dedicated software tool in order to take full advantage of EIS.

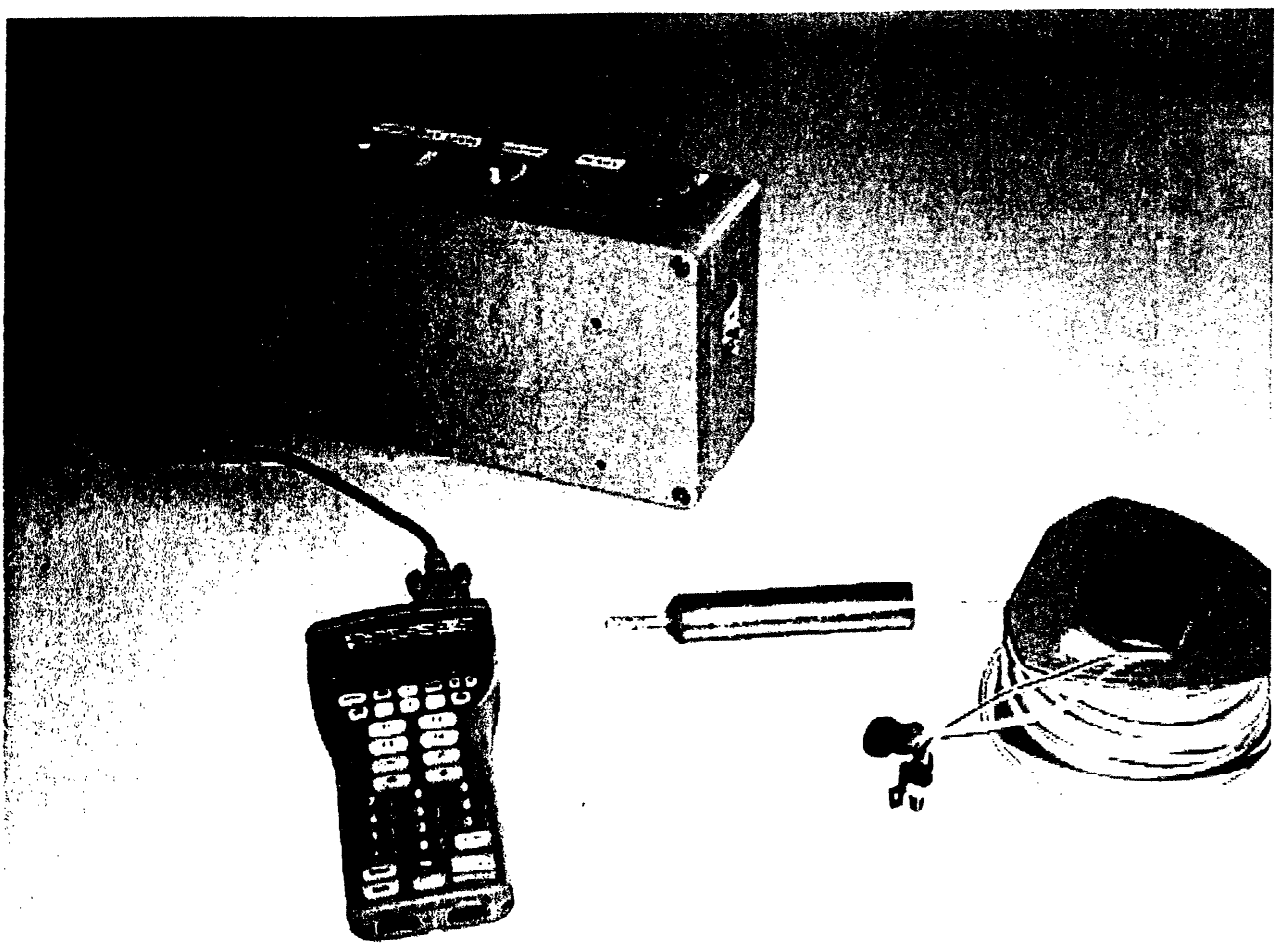
We will then demonstrate the capabilities of QUALITIR, our existing Integrated Blasting sw and finally we will describe our future software VISUAL BLAST ®.

2. ELECTRONICS INITIATION SYSTEMS - DSL 2

Electronic initiation systems now available in the market place provide new possibilities to solve blasting problems and improve mining operations.

They are used in various specific cases :

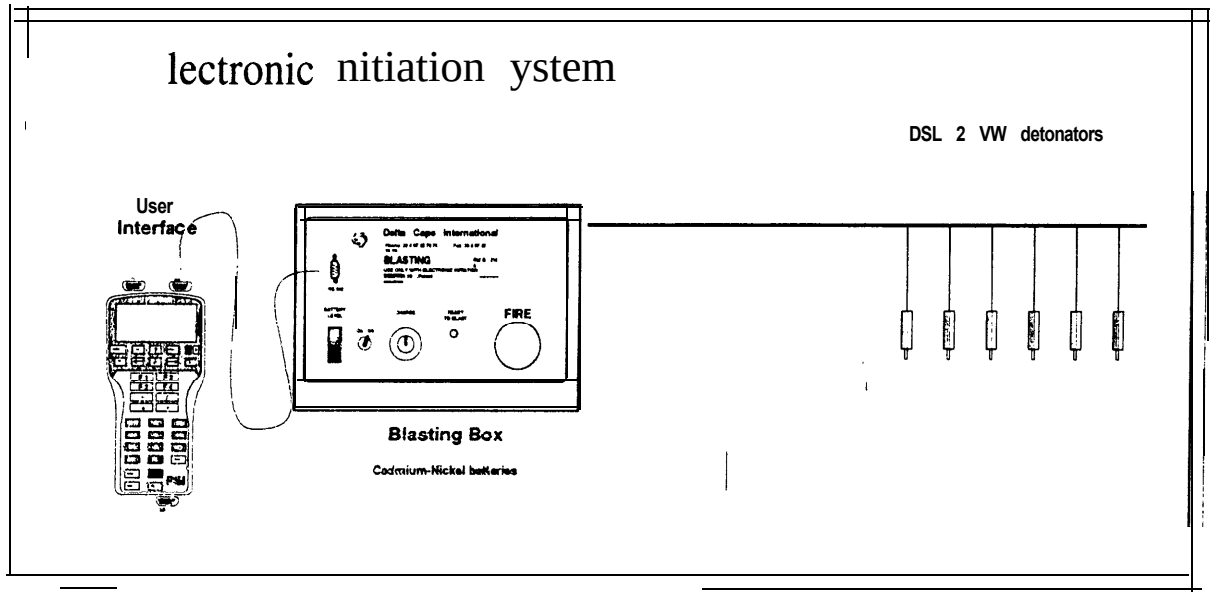
- vibration control
- large number of detonators
- blast in urban environment
- underground mining
- building demolition
- complement to air-deck techniques
- several row blasts
- presplitting blasts



2.1. DESCRIPTION OF DSL2 SYSTEM

2.1.1. The System

DSL 2 system is described in the figure below:



DSL2 EID (Electronic Initiation Devices) are controlled by the blasting box.

This blasting box provides several functions:

- Communication with EID
- Constant diagnostics
- Blast control
- Power EID

2.1.2. DSL2 EID

DCI develops and manufactures an electronic module that connects to a standard electric instantaneous detonator.

With this new approach, electronic modules are delivered to customers without pyrotechnic detonators.

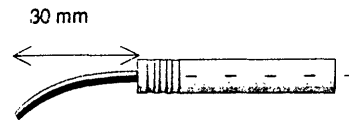
DCI has patented a new way to connect instantaneous detonators in an easy way, requiring a few manipulation.

Electronic modules come with a special plastic head-module half inserted at one side of the cylinder of the electronic module.

This head-module, specifically developed by DCI is compatible, with most electric detonators available on the market place.

As such logistics and storage are easily handled.

Instantaneous electric detonators are sourced from local distributors.

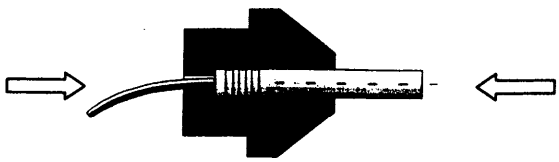


one side of the cylinder of the electronic module. Electronic modules come with a special plastic head-module half inserted at one side of the cylinder of the electronic module.

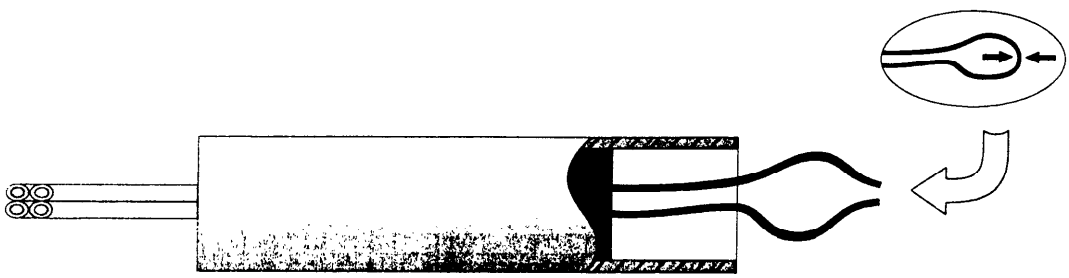
This head-module, specifically developed by DCI is compatible, with most electric detonators available on the market place.

First operator must cut wires out of the electric detonator to leave approximately 30 mm wire length.

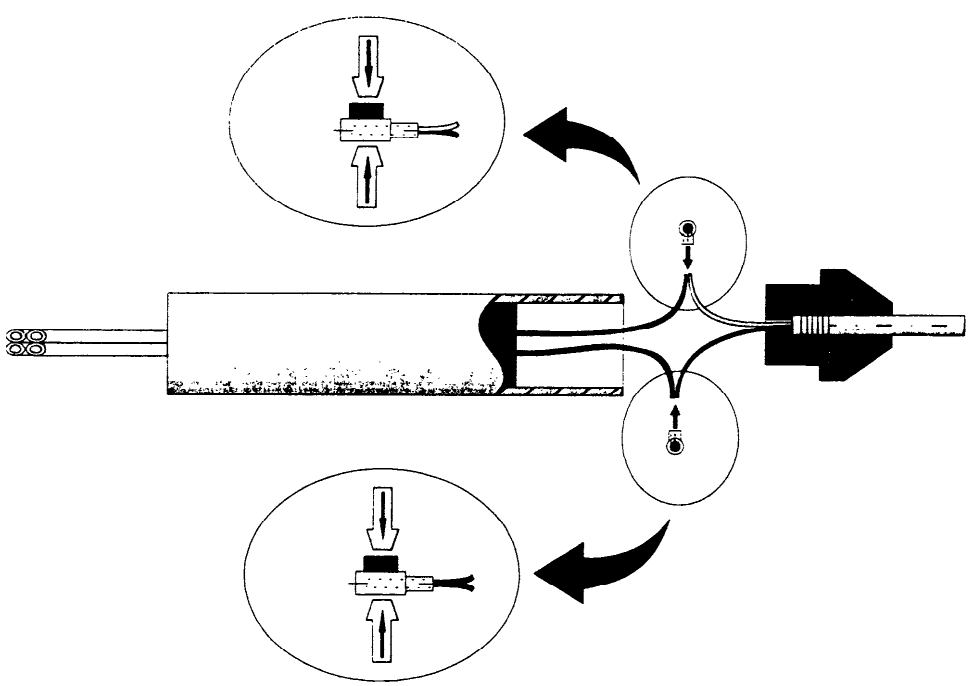
The electric detonator is then inserted into DCI head-module. DCI designed a special inserting tool to carry this task with safety and efficiency.



Then operator cut the loop of wire on the side of the electronic module:

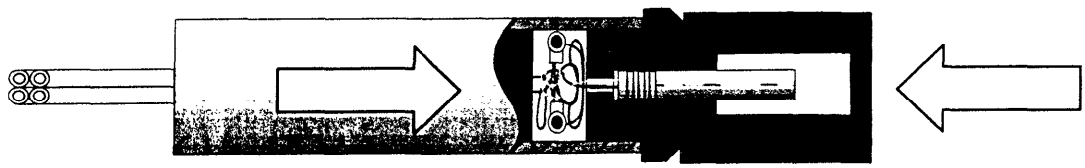


And the use specific and waterproof connectors provided by DCI to assemble detonator wires together with the electronic module wires:



These specific connectors are designed to provide a very high degree of functionality and reliability.

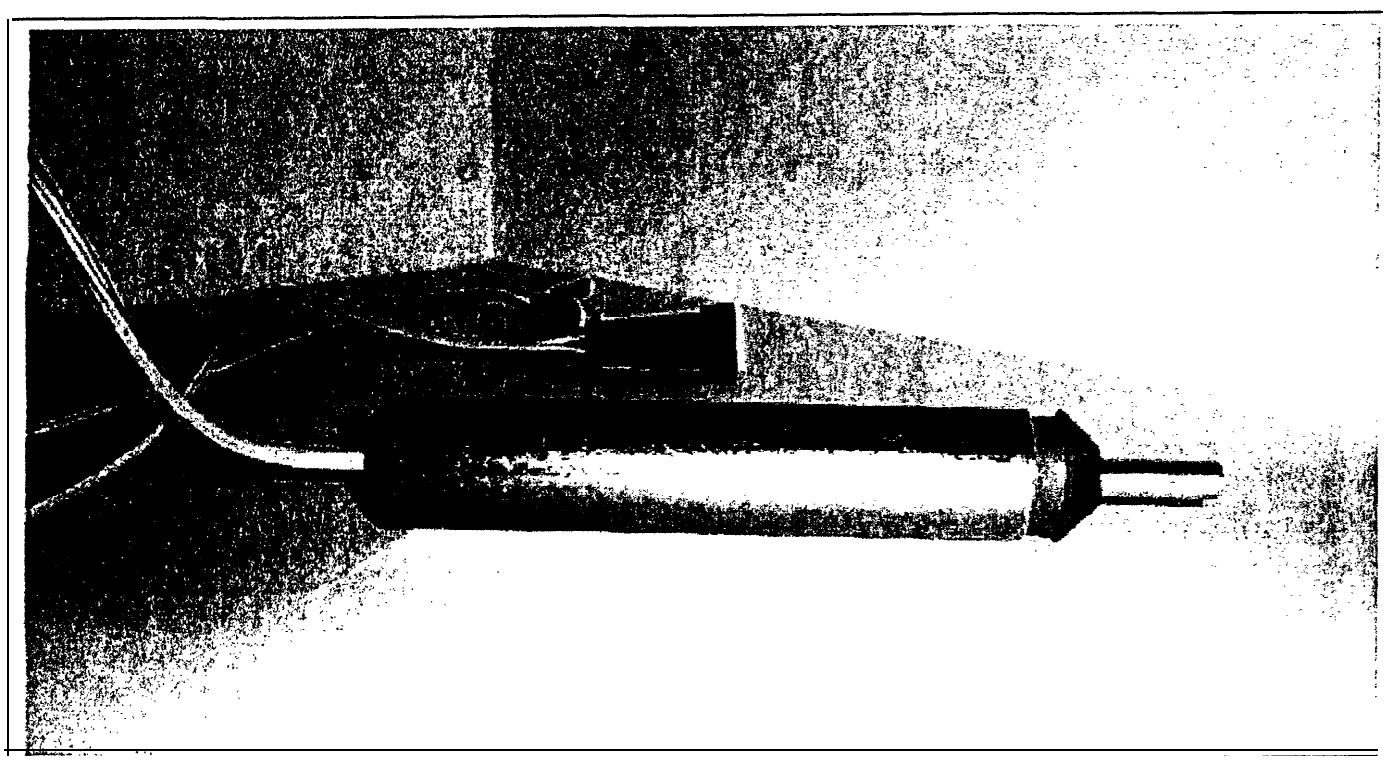
Then the operator inserts the electric detonator, together with the head- module, into the body of
the electronic module.



Once again the head-module has been designed so that it is extremely difficult to dismantle the finished electronic detonator. Finally the assembled system is waterproof and ready to use.

This new approach gives users or distributors the possibility to easily make their own electronic detonators based on proven technology.

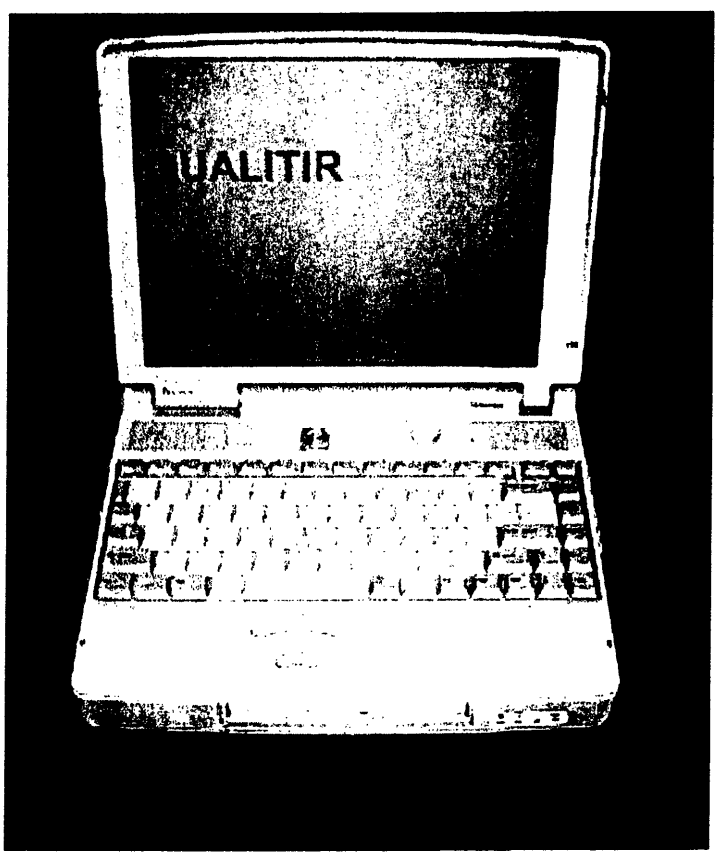
Pyrotechnics instantaneous detonators being widely available on the market place, DCI delivers only Electronic modules, which are not pyrotechnic devices.



2.1.3. PROGRAMMING

DSL 2 EID are all identical. They are not differentiated. They are inserted in the holes without any delays assigned to them.

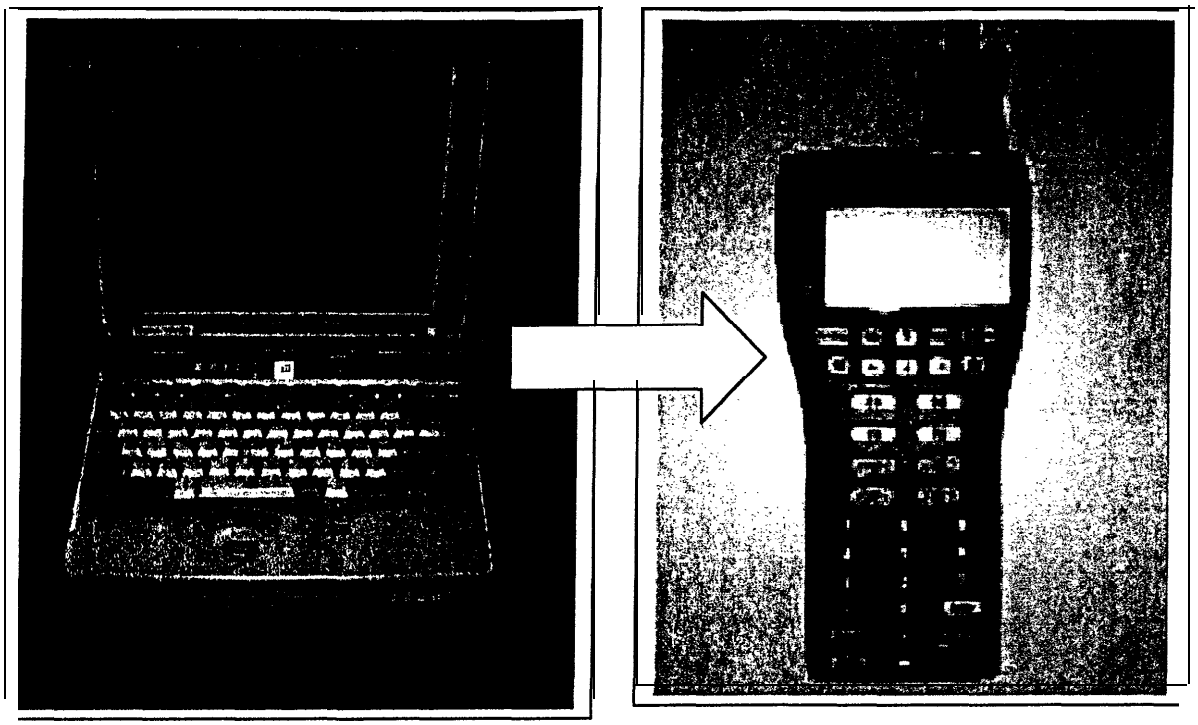
The blast sequence is usually designed prior to the blast by the mining engineer.



A PC running Qualitir or Visual Blast is used to design the blast sequence

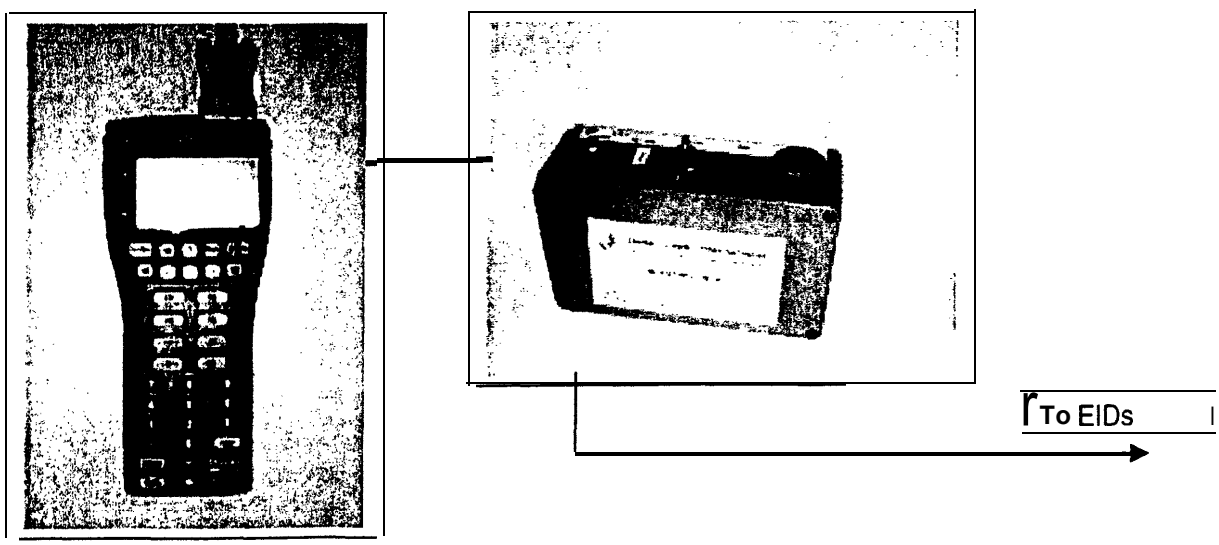
We will see later how blasting engineers can design their blast sequence using dedicated software tools.

Once the blast sequence is established it then downloaded to the hand-held User Terminal.



The User Terminal can store various blast sequences that can be activated by the blasting engineer in the fiefd. If minor modifications need to be added to the blast sequence (for instance less holes than planned) then the blasting engineer can easily modify the blast sequence from the User Terminal.

Their delays are programmed a few minutes before the blast. Delays are downloaded from the User I/F to the Blasting box and then to the EIDs.



3. SOFTWARE INTEGRATION

Among many parameters several can affect the outcome of a blast:

1. The pattern design
2. The hole loading design
3. The sequence design

EIS by themselves will bring few added value to point number 1 and 2. However EIS can bring huge benefits when an appropriate sequence is designed.

So far most of the tests blasts with EIDs were performed with sequences compliant to standard initiation system delays in order to have a back up capabilities.

As such EIS could only bring a better accuracy to blasters.

Accuracy is important because charges triggered by two standard initiation devices having different delays may blast at the same time

Similarly when simultaneous blast is required, this may not happen due to the large deviation for similar detonators (presplitting in underground cases).

These two facts lead to underestimate the notion of instantaneous charge

Accuracy is the first advantage EIS brings, however it is not the only one. Another key advantage of EIS is their flexibility in designing blast sequences. Blasters have now the flexibility to select their blast sequence in a much different way than what they used to do with standard initiation devices. They have the flexibility to select delays directly depending on their requirements.

DSL2 EIDs do not have internal predefined delays, delays are programmed a few seconds before the blast through the blasting machine that transmits the sequence.

If properly designed, an adequate blast sequence can bring huge benefits to blasters, but it must also be clear that a wrong choice of delays can generate negative outcome.

It is then important to assist blasters to make the right selection of delays depending on their requirements.

This is the goal of the various software packages that we have developed and that are connected to our EIS.

3.1. Requirements for Software integration

A proper software for blasters must be

- easy to use,
- it should guide users
- it should simulate and optimize
- it should be visually explicit
- it should be consistent
- parameters should be entered in an easy way

DCI developed a set of software tools :

- Qualitir
- Visual-Blast ®

3.2. Qualitir

Qualitir is a software developed by DCI in a 5 years effort. This tool designed by specialists for professionals is a decision aided design tool.

Qualitir is focused in designing blasts. Namely, blasting sequences, fragmentation as well as the study of vibrations are adressed. QUALITIR helps in optimizing blasts in terms of performances, of profitability, security and impact on the environment.

Several years have allowed to validate both the software but ealso the numerical model (statistical models not but analytical). These models leaning on the different physical principles governing actions of the explosives.

Qualitir has been developed with the following principles in mind:

- Establish efficient blast designs in a minimum of time
- Identify a plan of loading
- Visualize the seismic result of a shooting of blast
- Interpret, analyze, process the different signals
- Simulate the result of a blast
- Visualize the damage of rock with a given loading.
- Conviviality
- Rapidity of execution
- PC based

QUALITIR has six independent modules allowing to realize well specific tasks :

. LOADING : Relative data seizure to the loading of a hole..

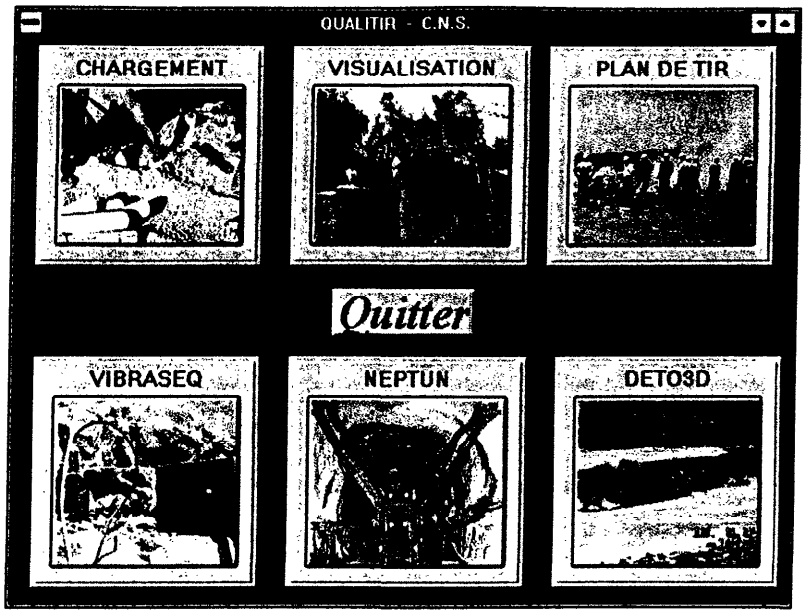
. VISUALIZATION: Modelisation of the wave propagation of a blast.

. PLAN DIGN : Sequences design.

. VIBRASEQ : Analysis and processing of the signal adapted to most recent techniques concerning control of vibrations.

. NEPTUN : Implantation of the different holes of a flight in tunnel, according to the principle of the cut of large empty hole drilled in spiral and widened to the diameter of the gallery.

. DETO3D : Determines the damage of rock according to a stemming loading of a hole



3.3. **Visual Blast ®**

This blasting software developed by DCI is dedicated to blasters. It is not a tool dedicated to experts willing to simulate and analyse blasts.

It allows blasters to define what they want it terms of blast outcome through a few parameters.

These parameters are:

Direction of opening

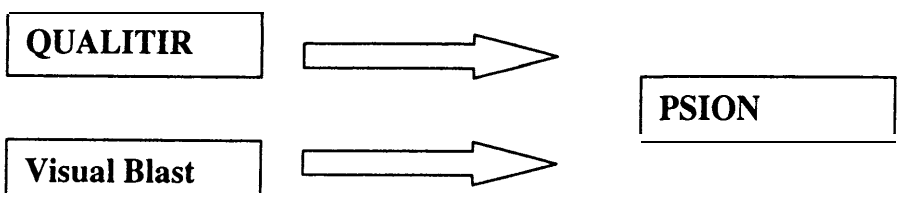
Direction of the blast

Minimum inter-hole delay

Visual-Blast will then process and display all the parameters to blast.

3.4. Integration

Visual-Blast and Qualitir are tools that are used to design a blasting sequence. Once blasting sequences are designed they are then downloaded to the blasting machine before the blast.



3.5. Conclusion

DCI has developed an EIS in order to provide a global approach to the blasting process. Our major goal is to take into account blasters requirements from start, expressed in simple terms and propose tools that wilt process these requirements and provide a valuable and efficient blast sequence that will take full advantage of the flexibility and accuracy of DSL2 – EIS.