Lecture W8

Use of Explosives and Safety in Quarries

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1. INTRODUCTION

Some regulations exist, quite everywhere, to deal with safety requirements during blasting in quarries or for civil work. These are very important when subcontractors of the quarry perform blasting.

The detailed analysis of an accident that occurred in a quarry in France in 1997 (three fatalities) and of some other near-accidents show that human behaviour is an important factor of accident during blasting operations.

The purpose of this short presentation is, after a summary of this accident and incident, to point out some needs for improvement of existing procedures.

2. CHATEAUMEILLANT ACCIDENT - 1997/02/03

2.1 Description Of The Accident - The Facts

On February 3rd, 1997 at 5:00 PM, three employees of a quarry where killed buried beneath several hundreds tons of rocks. They were in a van in their way out of the blasting area, when the explosives were fired.

In this quarry, a subcontractor of the quarry did drilling, loading and blasting operations.

At 4:45 PM, once all preliminary operations were done, the quarry manager asked the three employees to park their engines at the bottom part of the quarry and to evacuate the hazardous area with the van. Then, after he saw the van leaving the bottom part of the quarry and he got radio confirmation of that, he went to the observation post and, a few minutes before 5:00 PM, asked three short blasts to be given on the hooter.

In this quarry, the usual procedure is that the quarry manager allows the blasting after verifying the achievement of the evacuation of people in safe areas. This authorisation to fire is given to the subcontractor foreman using a visual signal done with the two arms.

The subcontractor foreman was located at some hundred meters from the quarry manager, at the top of the blasting area, at a place where he had no view of the part of the quarry below him.

Even though the third blast on the siren was not achieved and even though the quarry manager did not give the authorisation to fire, the Blaster fired off. The van was just passing the bottom of the blasting area at this moment!

2.2 Investigation Of The Accident

The case came before the court and, according to judicial inquiry, it is possible to draw the scenario of the accident as follows.

The subcontractor foreman said he did not give the order to fire off to the Blaster located some twenty meters below him. But he asked him to be ready to do so. The Blaster

misunderstood that as an authorisation and started (at the second blast on the siren) to charge the blasting machine and then, fired off.

Both the Blaster, who was not familiar with this quarry, and the foreman had signed, more than one year before, a register to testify that they had read and understood the written safety rules applicable in the quarry.

The Blaster said to the court he was thinking that the first blast on the siren was given only after achievement of the dangerous area evacuation, and that firing off could be done one minute after the last of the three blasts on the siren (lapse of time he did not respect!).

The foreman said that it was usual to connect the explosive charges to the blasting machine far before the last of the three sound signals, and then, just after this third signal to fire off at seeing a visual signal given by the quarry manager.

The quarry manager said he did not give this visual signal, but he asked for the three blasts on the siren to be given, even knowing that the van was not out of the dangerous area.

In this quarry, the written provisions for safety were that the firing operation, starting with connecting the charges to the blasting machine, should be done only after all employees escaped the dangerous area and after verification of that by the quarry manager.

It was not so clear in the written procedure, if the connection of the explosive charges should start after the three blasts on the siren or not.

It was also not clear in the written agreement between the quarry and the subcontractor, who had the responsibility for blasting.

Regarding French general regulations the person who activates the blasting machine is responsible.

But in this case the Blaster, employee of the subcontractor, had neither the authority, nor the means to control the evacuation of the dangerous area.

3. RECENT NEAR ACCIDENT INVOLVING NEF EMPLOYEES - 2001/03/01

3.1 Description Of The Near-accident - The Facts

On March 1st, 2001, at 3:30 PM two NEF employees were completing checking remaining explosives in their delivery van located at the front base, at less that three meters from some “relieving holes”, when the blasting occurred. The truck was riddled with rock fragments. Fortunately the two employees have not been injured.

In this quarry, a subcontractor also did drilling, loading and blasting operations.

Again, in this case, the quarry manager authorised the blasting without checking if the dangerous area was fully clear...

The Blaster, employee of the subcontractor, was waiting for the clearance to fire the explosives, concealed in a shelter. He was not in a position allowing checking all the blasting area was clear.

3.2 Investigation Of The Near-accident

Even if it was not an accident (no one was injured) NEF asked the quarry and the subcontractor to take part in a cause analysis working group. This has been done using a “Fault-tree” method.

NEF employees went with the van from the main blasting area to the secondary area at 3:15 PM to load “relieving holes”.

The Blaster said to NEF employees that they would meet after the blasting. Then he went to the quarry manager’s office and told him that he is ready for blasting. The quarry manager answered that he will clear the quarry and ask the access gates to be shut.

On his way to the shelter where he will fire off, the Blaster asked one truck to be shifted and a mechanical digger to stop working. By radio he informed the quarry manager.

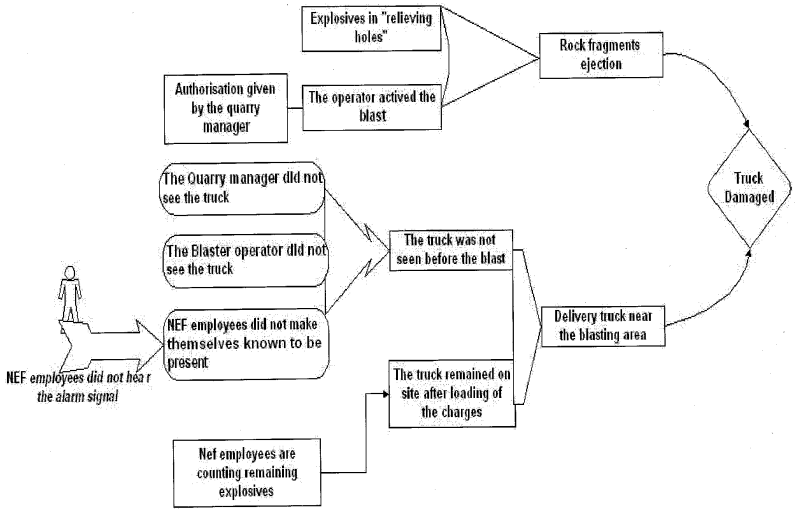
From the shelter, the Blaster did not see any other vehicle. By radio he confirmed to the quarry manager that he is ready for blasting.

After a quick visual control, the quarry manager confirmed by radio to the Blaster that nobody is remaining at the bottom of the blasting area. Then he went to the office and asked for three blasts on the siren (not heard by NEF employees in the van).

Some 30 to 40 seconds after the sound announcement, the quarry manager gave to the Blaster the permission for firing off the explosives.

It is only after the blasting was done that the quarry manager noticed the NEF van.

3.3 Fault Tree Analysis



3.4 Near Accident - 2001/03/01 - Corrective Decisions

Considering fault tree analysis, the following corrective decisions were made:

A) Authorisation given by the quarry manager

If the authorisation is given by radio means, the Blaster operator must repeat the message in order to insure it has been properly understood.

B) The quarry manager did not see the truck

Make rounds before giving authorisation for blasting

C) The blasting operator did not see the truck

Make a better choice of the location of the operator for a good seeing of all hazardous area

D) NEF employees did not hear the alarm signal

Increase of the power of the hooter and fire off at least two minutes after the alarm signal in order for the employees that are not under cover to express them.

E) NEF employees count remaining explosives on site

Design a safe area, in each quarry, for this post delivery operation.

4. LESSONS FROM THIS ACCIDENT AND INCIDENT

From NEF point of view, four main lessons can be drawn from the Chateaumeillant accident and the near-accident described below.

4.1 Need For More Simple Procedures

In France, some legal procedures exist, especially when a subcontractor is acting (in French = PLAN DE PREVENTION).

But the support document signed by both the quarry manager and all subcontractor team managers is very heavy.

This document where are written all safety provisions that should be known by every actor of the blasting process, is generally not read; and does not lead to clear and simple written orders.

We think that the operational safety directive should be summarised in ONE SHEET, at a maximum.

4.2 Need For Harmonized Procedures

Of course there are codified signals (sound, visual,...) in each quarry. But they are different from a quarry to another. This is a major problem for employees of subcontractors that may work in a number of different quarries. Many mistakes are resulting of that.

Signals should be harmonised at a national level in France (a working group has been set up under French competent authority) and, why not, at a European level.

4.3 Need For Clarification Of Responsibilities

Procedures are not very precise concerning who is responsible and who checks what. This is particularly important when people involved in blasting operations are under two (or more) different authorities.

All obligations resulting of interactions between the quarry and the subcontractor authorities have to be precisely written down.

There should be a joint reading of the associated document before signing.

4.4 Need For Mutual Information On Specific Risks

There are specific risks for each activity: quarry operating, drilling, use of explosives... When different professions intervene in the quarry, the others should know the risks generated by each of them.

For our part we consider that, as explosives manufacturer and distributor, it is our duty and our responsibility to train our customers (quarry, driller-blasters,...) on specific risks of our products.

But, on the other way round, we regret deeply that the risks generated by the quarry operations are not well known by our employees... Some improvement has to be done on that precise point.

5. CONCLUSIONS

On a quarry, for blasting operations, human behaviour is a key element for safety.

It should then be managed rising precise rules or regulations.

These rules must not be in a position to be interpreted (and misinterpreted!).

These rules must then be very easy to memorise and should fit into a single paper sheet.