# EFEE NEWSLETTER

## December 2015

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# NEWSLETTER

## December 2015



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We in EFEE hope you will enjoy the present EFEE-Newsletter. The next edition will be published in spring 2016. Please feel free to contact the EFEE secretariat in case:

- You have a story you want to bring in the Newsletter
- You have a future event for the next EFEE Newsletter upcoming events list
- You want to advertise in a future Newsletter

Or any other matter.

*Igor Kopal, Chairman of the Newsletter Committee and the Vice President of EFEE -*

*newsletter@efee.eu*

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## Dear EFEE members, the president's voice

Northern Europe is already experiencing minus degrees, while southern Europe will see rain and low temperatures before long. I have personally already been challenged by 60 cm of snow in a single night this winter. In due time most of Europe will be covered in snow and Father Frost will ensure the fourth season. Christmas markets will appear across our continent and trees and houses will be decorated with lights. Families will gather for this season of giving and love. The end of the year is running out fast and a new and interesting one is approaching step by step.

This is the last newsletter of the year, we will inform you about current events and developments in the explosives sector and the European Federation of Explosives Engineers itself. This is combined with relevant technical articles.

The EFEE council gathered for two important meetings during 2015. First, we met in April in Lyon, France: The meeting was held in connection to the 8th EFEE World Conference on explosives and blasting a success in all matters where specialists from the world meet for two days. EFEE thanks the two national French organisations for their great work and look forward to the 9th EFEE conference in Stockholm in 2017.

The second meeting was held in Barcelona, Spain, where the Spanish organisation took part of the meeting.  The main topic was the result of the EFEE conference in Lyon, which superseded the result of any past conference in all manners.

The board has met twice apart from the mentioned gatherings of the council, the most important to mention is the meeting with the EU authorities during our February meeting in Brussels. EFEE was received with professionalism and our representation of the national blasting associations was met with interest by the EU authorities. The meeting resulted in a further broadening of EFEEs participation in the different EU boards and we are now represented in several forums in EU relevant to our trade.

During the year EFEE has continued the work in supporting authorities and other organisations of the business for the benefit of our field. EFEE has continued implementing our strategy for the future and has had a success in increasing the number of members.

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I would like to give my sincere thanks to our Federation's partners for their great support and trust. Many of the services that EFEE provides to its members, participation at numerous committees and expert panels, involvement and active contribution to working out European directives and regulations would be impossible without their extensive support. The same goes for our Secretary General Roger Holmberg who is of great importance for the federation.

On behalf of the EFEE Board I wish all members, colleagues and friends of the Federation a fulfilling holiday Season, a peaceful and reflective Christmas with their loved ones as well as a happy and prosperous 2016.

We are looking forward to seeing you again at the next Council meeting and General Assembly which will be held in April 2016 in the UK.

*Johan Finsteen Gjødvad, President of EFEE*

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## Meeting the Explosives Working Group

The annual meeting of the Explosives Working Group took place on 26th October 2015 in Brussels at which the European blasting federation EFEE has been an active and permanent observer for many years. The Explosives Working Group is run by the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs with its Head Federico Musso.

It deals with the issues of applying explosives for civil use. New and changing technical requirements for explosives as well as the regulatory framework for using explosives for industrial or civil purposes are discussed and determined by the Working Group. Central point's thereby are issues in connection with placing explosives on the European market. As companies in the explosives sector tend to operate more and more transnationally, these topics as well as the Working Group itself become increasingly important. This is underlined by the developments in recent years such as the topic of Track and Trace of Explosives as well as documentation for placing/intra-community transportation of explosives.

Central point of the meeting was the Directive 2014/28/EU of 26th February 2014 (new explosives directive) and its imminent implementation into national law by the member states. This Directive must be implemented by its member states by 20th April 2016. The Directive's central point deals with the revision of the requirements to be met by all Notified Bodies on order to continue to work as such. This shall ensure that the work of these institutions provides comparable results which is not only in the interest of all manufacturers and users of explosives.

Another focus was laid on the reports on the blasting companies' progress of implementing Directive 2008/43/EC (Track and Trace of Explosives). As part of the meeting the UEPG as well as the European Federation of Explosives Engineers described their experiences. It became clear that the term "end user" is partly interpreted differently by the different member states. As a consequence, in some countries the chain of retracing does not end at the user (end user – blasting company) but already at the manufacturer. At this point one has to ask how far this corresponds with the target of Directive 2008/43/EC. Furthermore, the different points of view can distort the competition.

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During the presentations it was also discussed how to handle remaining stocks of explosives that according to the manufacturer’s information can still be used but were made and put on the market before the Directive came into effect and thus do not have any labelling in accordance with the Directive. The Commission expressed during the discussion that answers and solutions to these questions should be found by the member states by making pragmatic decisions.

Finally we from the EFEE can once more state that the topics of the meeting as well as the presentations and discussions are crucial for the members of our Federation. By being part of this Committee we can actively develop and shape these processes and thus represent the interests of our members as best as we can.

*Jörg Rennert, Member of the Board, EFEE*

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# Controlled Blast induced Liquefaction of water saturated sands, using 250 m long horizontal holes and electronic detonators

The mission of the project is the fast and cost-effective rehabilitation of decommissioned lignite mining and coal upgrading facilities. This is necessary to ensure the  successful future utilization of these sites. On the one hand,for founding new industrial and commercial facilities and on the other hand for touristic activities.

An important goal is to reach stable conditions at the worked-out open-cast mining cuts, which have been flooded and created residual mining lakes. At the water line of these lakes big mounds of unstable water saturated sands with a height of up to 25m have been deposited.

The idea was to drill 250 m, high accuracy guided, horizontal drillholes underneath the unstable sand formations. To reach the needed accuracy of drilling, a combination of airborne and civil engineering technology was used. All holes drilled had to be cased. The paper proposed will present the test blast procedure and the results of pore pressure measurements for the particular conditions. In the second part of the paper the unique use of 250m long electronic detonators in horizontal holes with up to 14 decks will be described.

In this project a safe and reliable working procedure had to be carried out to guarantee the highest possible standard of safety. Mass induced Tsunami waves and blast induced vibrations propagated over 1.6 km in length without any attenuation.

The combination of high accuracy horizontal drill holes with a deviation of maximum 1.0 m (3ft) at 250m (~800ft) length and electronic detonators showed perfect results regarding calculated liquefaction of water saturated sands. The work presented is the basis for upcoming future projects in this area.

### Liquefaction at decommissioned lignite mines

Liquefaction is an occurrence happening in loose saturated sand deposits due to increase of excess pore pressures initiated by vibrations, shock waves, increase in surface loads or groundwater tables.The phenomena is also observed in decommissioned lignite mines such as the old mining areas in the Lausitz because as the result of deposing the excavate sands in mine dumps. Four soil mechanic criteria’s lead to sand deposits endangered to liquefaction:

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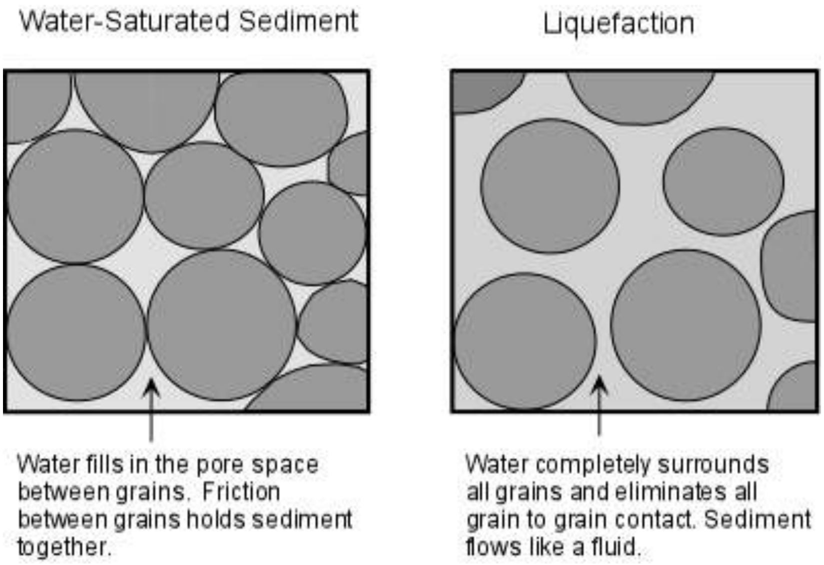
• High degree on water saturation
• Very loose to loose bulk density
• Round and smooth form of sand grains
• Characteristic grain distribution with uniformity (U~3) and fine grain parts [0,06 mm 5 % to 20%]

A total collapse of the grain skeleton will occur during liquefaction. The soil consists of a three phase material consisting of sand grains, pore water and air. Once the skeleton collapses a sort of avalanche flow happens (BKK Senftenberg and TU Bergakademie Freiberg, 1985). The strength or apparent strength is immediately reduced to a minimum. Figure 1.




*Principle of liquifaction*

In the Lausitz area most of the time this is linked to an increase in groundwater table due to heavy rainfall or many years after closing of the mining area and shut down of the water management. Liquefaction in areas of public access is dangerous and ignoring the rules and guidelines humans, animals, equipment, buildings etc. can be injured, buried or damaged.

Controlled liquefaction is used to restore decommissioned lignite mine areas and to gain new safe and stable ground surface areas for buildings, leisure facilities and similar. Horizontal directional boreholes with a depth of up to 250 m (~800ft) are drilled and explosives are placed in the holes to initiate a controlled liquefaction process to improve the ground conditions and to relocate loose overburden along the coastline of the lakes found in the decommissioned lignite mine areas below the watertable of the lakes, see Figure 2.

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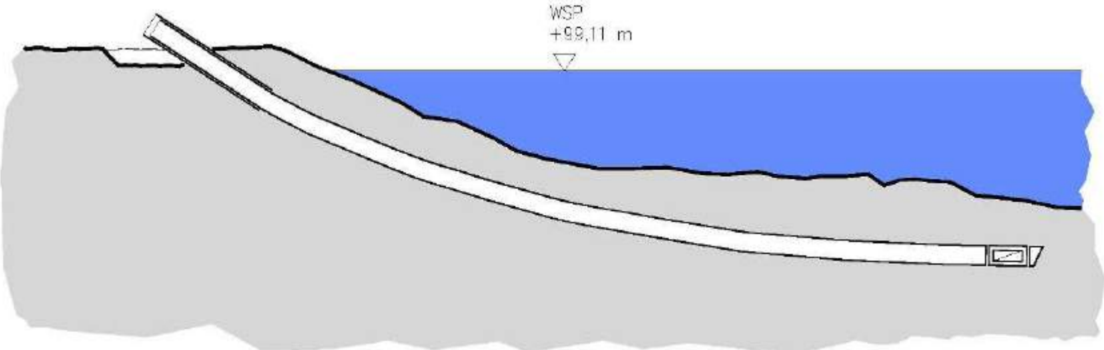
*Mine dumps at the lake „Nordrandschlauch", decommisioned lignite mine Spreetal; Arrow 1 – loose mine dumps at the coast line Arrow 2 – improved slopes*

**Horizontal Drilling technique**

The boreholes are drilled with a modified Directional Horizontal Drilling (HDD) technique using a casing and detachable lost drilling bit. The casing is used to continuously support the borehole until the temporary PVC casing is installed. The drilling techniques has the advantage of forming a closed system during drilling and installation of the PVC casing up to final installation of the explosive in the blast hole in the loose sand deposits. After completion of the drilling at the final depth the PVC casing is pushed in the steel casing and used to unlock the detachable drilling bit. The borehole is continuously surveyed during drilling by a steering tool. The as-drilled data is send to the surveying computer at the drilling rig and compared with the designed borehole alignment. In case the alignment is out of the tolerance the borehole is corrected to achieve a minimum offset. In Figure 3 the schematic of the drilling is shown.




*Drilling of the blast holes with HDD technique and surveying tool*

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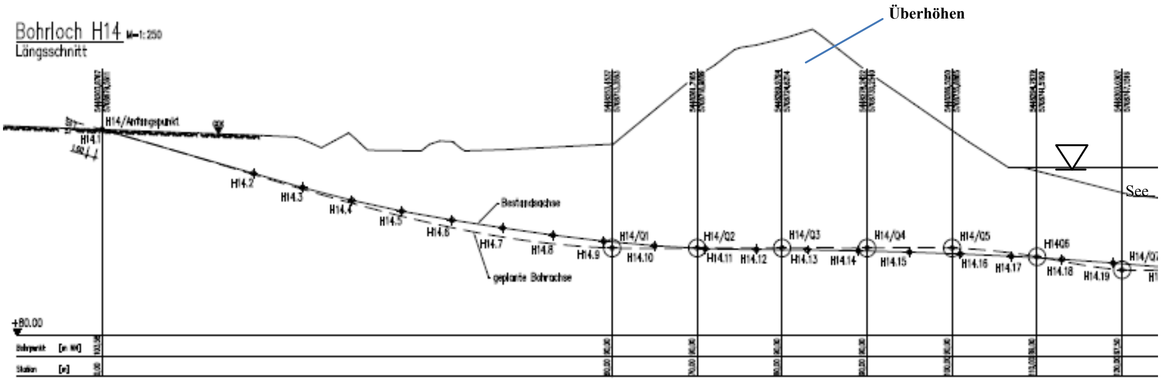
To be able to correct an offset or to drill a curved alignment the position of the drilling bit needs to be known at all times during drilling. Drilling a curved borehole alignment in very loose to loose sands is difficult due to the limited earth resistance needed to push the drilling bit. An accurate design of the borehole and knowledge of the ground is required to drill the complex alignment as designed for this project and shown in figure 4.




*Sample of borehole alignment*

The borehole passes through several target points for the installation of the explosives in distances up to 15 m between each loading point. In total up to 15 target points had to be passed with the drilling.The maximum off set of an target point allowed was 1,0 m (~3ft).

## Test blast procedure – Evaluation of Pore water pressures

For the planned tests (Test fields 1 & 2) pore water pressure transducers have been mounted in separate drill holes up to a depth of 200m (640 ft).

The drilling was done with the horizontal drilling technique described above. Due the drilling of the holes it was necessary to prevent the closing of the pores at the outer surface to guarantee the impeccable functionality of pore water pressure transducers. Therefore the bentonite content was reduced to a Minimum. The drill bit was supported with a special nozzle to achieve the same drill speed with water flushing than with bentonite.

Figure 5 shows an example how a transducer was mounted and fixed at a polyethylene pipe. Every single transducer was connected to a data logger through a cable running in the inside of the polyethylene pipe. The programming of the transducers was matched to the blasting time and firing intervals.

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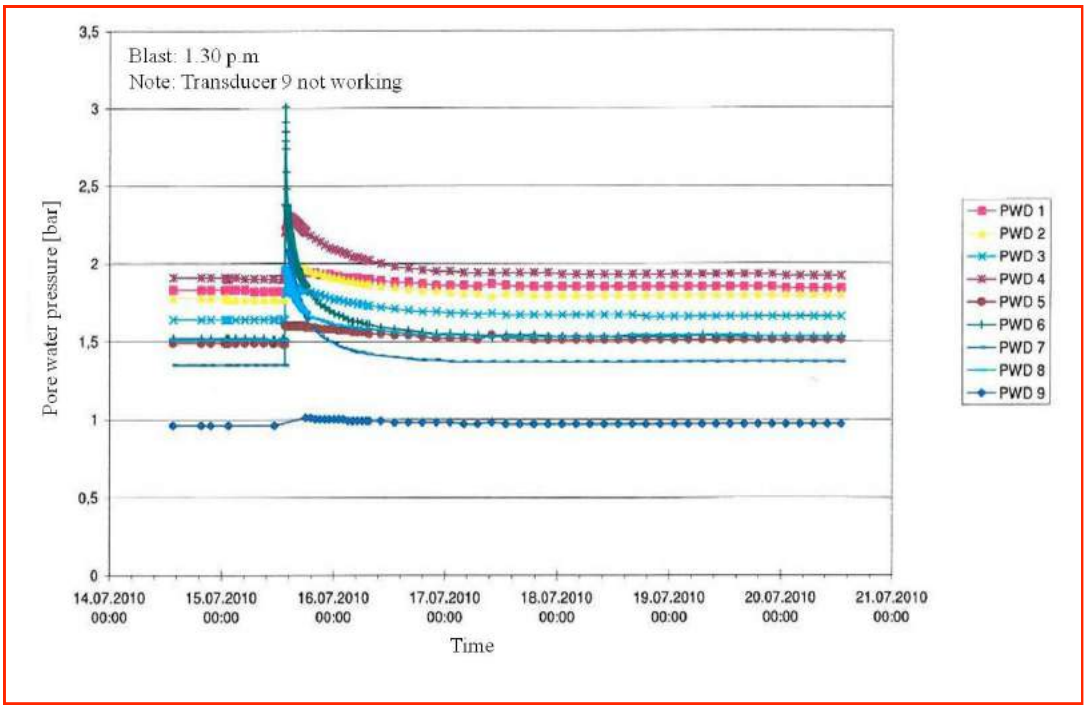
*Pore water pressure transducer prepared to use in horizontal drill holes (Test 1 und 2)*

The data collection of the blast induced pore water overpressure at test blast 1 (transducers between two blastholes, 12.5m distance) was not successful. The cable connections tore off due to ground movement. The measurements at test blast 2 showed results until 5 days after the blast. The transducers were placed between two blastholes but 5 m below the blast hole level. The measured results are visible in Fig. 6.




*Pore water pressure measured 5 m below blast holes at test blast 2*

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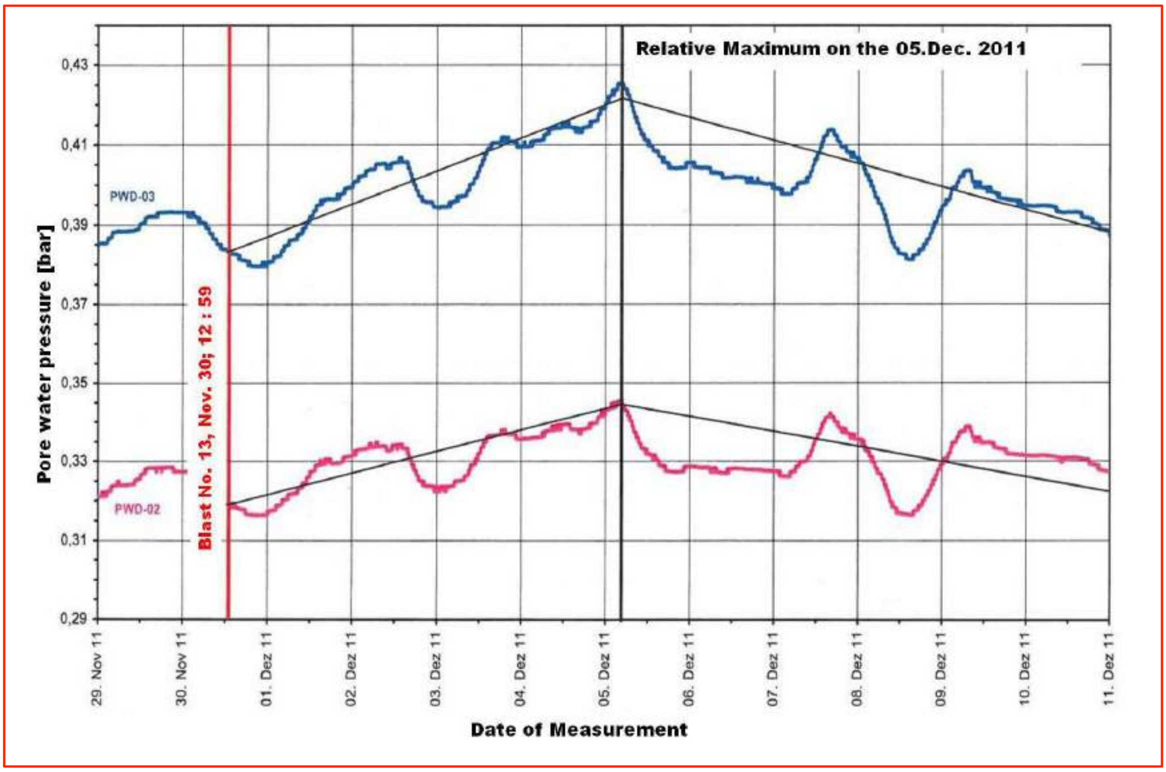
The measured values have been mostly plausible but showed, that pore water pressures, necessary for a 100 percent liquefaction has only been reached at certain transducers (Transducer 6, 7 & 8). The measurements also showed, independently from the geographic position (elevation) of the highest pore water pressures (measured), that 24 hours after the blast the pore water pressure returned to normal values, measured like before the blast. This implies that a successful shorttime liquefaction close to the blast area (Sudden increase of pore water pressures) and an exculpatory outflow procedure (relatively fast decrease of pore water pressures) could be proved. The far field monitoring of the pore water pressures showed, that the increase and following decrease of the pore water pressures appeared significantly time delayed compared to the shot time.




*Pore water pressures after blast No. 13 (distance to blast: Transducer 2: 1450 m/4757 ft, Transducer 3: 1400 m/4593ft)*

The measured curves after blast No. 12 & 13 showed significantly increasing pressure values and reached a relatively Maximum between day 5 and day 8 after the blast (Fig. 7).

The measured values 5 and 8 days after the blast reached 0.080 bar…0.045 bar (8 cm or 3.15 inch water level up to 45 cm or 17 inch water level), compared to the pore water pressures before the blast. This confirms that the water saturated formations have been in a dynamic stimulated state, one week after the blast.

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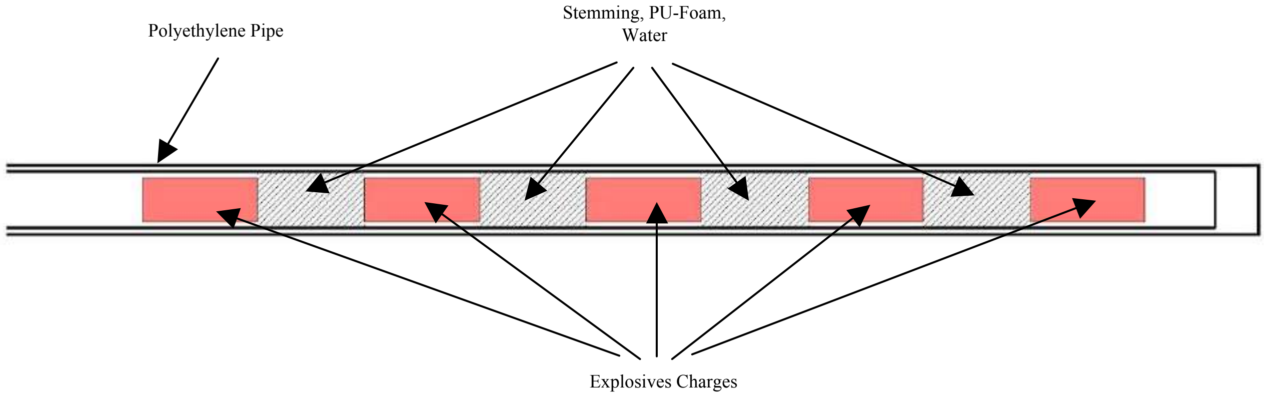
## Blasting Technique

The technical blasting details have been worked out and realized from Austin Powder International.The explosives charges had to be placed at an exact position depending on the results of geotechnical calculations and survey of the existing drill hole. The explosives were initiated with electronic detonators. These electronic detonators had wire length of up to 250 m (820 ft). The advantages of 250m (820ft) long detonator wires are, that there are no connections necessary within a drill hole. All connections between detonators and the bus line could be done at the surface, outside of the water filled blast holes. This guaranteed that every single detonator could be checked and reconnected at any time during the programming and testing phase of the initiation system.

The charges itself (14 decks) have been prepared at the surface in a polyethylene pipe (blasting pipe) with length of up to 250m (820ft).

In this blasting pipe the explosives charges (up to 14 decks) and detonator wires were protected from the polyethylene pipe outside. To avoid an initiation of a deck through the shock wave of a firing charge, polyurethane foam and water was used as stemming between the decks.The average distance in a blasthole from charge to charge was 10m(32ft) to 15m(49ft).




*Blasting Pipe with up to 14 decks/charges (Austin Powder)*

Another big advantages having this blasting pipes containing the deck charges was, that the whole pipe, once loaded, could be recovered from the drill hole if a technical problem occurred.

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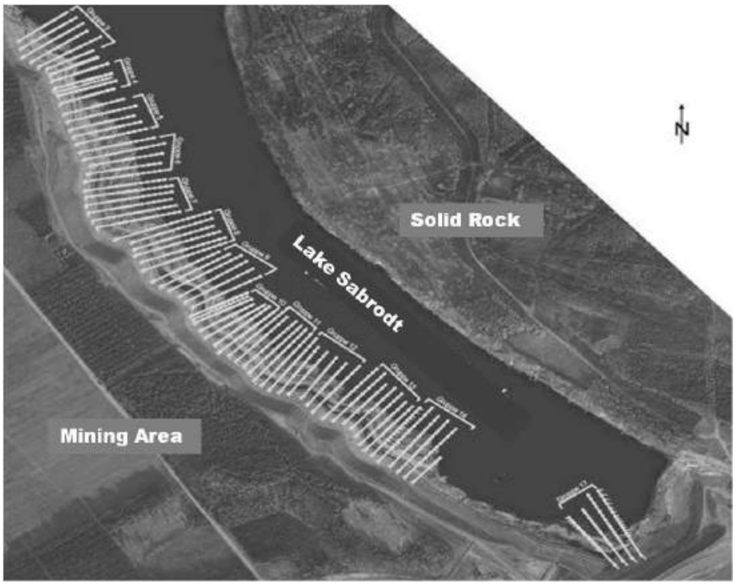
*Blasting Pipe with up to 14 decks/charges - realized (Austin Powder)*

In total 13 blasts with 91 drill holes were planned at a water level between +99 m (324ft) and +101 m (331ft). The starting point of the parallel holes was in the safe area of the coast line of the lakes. The side spacing between the drill holes was designed to be 25m (82ft).The drill length was 130 m (426ft) to 250 m (820ft). It was planned to use 7 to 14 decks per blasthole with 5kg (1l lb) to 25kg (55 lb) charge weight each. The total charge weight per hole was: Qtot,BH = 105 to 220 kg (231 lb…..485 lb).

In one blast group an average of 6 holes were fired with a total quantity of explosives Qtot,group = 497.5 to 1202.5 kg (1096 lb…2650 lb).




*Position of blast groups at Lake Sabrodt*

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## Timing

The firing time was designed according to the geotechnical situation and blasting parameters. All detonators were programmed after loading the charges in the bore holes, one hour before the shot.

Detonators

Connector Block

Blasting Machine & Logger

*Detonator, Connector Block, Blasting Machine and Logger (Austin Powder)*

To minimize the generated vibrations and to increase the time of liquefaction the timing between the blast holes was chosen to be 100 ms ≤ ΔtHi ≤ 500 ms. The time delay ΔtQi between the decks within a blasthole were 100 ms ≤ ΔtQi ≤ 1000 ms.At blast No. 1 two or more charges were detonating at the same moment. This lead to relatively high vibrations at Objects nearby. To avoid this effect an additional time delay of Δti = 12 ms for all charges in a blast group was programmed.

A very important effect for the time of liquefaction and the success of the blast is the excitation time ttot. This is the total time of the dynamic excitation within a blast group. The firing time between the first charge and the last charge in a blast group was 3238 ms ≤ ttot. ≤ 8047 ms.

| Description | Start of blast / Energy input | Continuing energy input / start of movement | End of blast, No energy input / Movement | Main phase of movement |
|---|---|---|---|---|
| | | | | |
| Time | 2 - 3 sec | 3 - 5 sec | 6 - 10 sec | < 20 sec |
| Indication | f = 3.5 Hz | f = 3.5 - 2 Hz | f = < 2 Hz | f = < 2 Hz |

*Phase Model liquefaction*

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**Blasting Parameters Blast Group 17**

Qtot,Goup: 660.0 kg

Drillmeters / Group: 849.0 m

| Hole No. | Azimut [°] | No. of Decks | Quantity Explosives / Hole Length [m] | Blast Parameter | | $Q_1$ | $Q_2$ | $Q_3$ | $Q_4$ | $Q_5$ | $Q_6$ | $Q_7$ | $Q_8$ | $Q_9$ | $Q_{10}$ | $Q_{11}$ | $Q_{12}$ | $Q_{13}$ | $Q_{14}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H88 | 331 | 14 | 227.5 | $Q_i$ | [kg] | 10 | 20 | 15 | 15 | 17.5 | 20 | 20 | 25 | 20 | 17.5 | 15 | 15 | 10 | 7.5 |
| | | | | $h_0$ | [m NN] | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| | | | | dh | [m] | 11 | 13 | 14.5 | 15 | 16 | 16.5 | 16.5 | 17 | 16.5 | 16 | 14 | 10 | 8 | 7.5 |
| | | | 196 | a | [m] | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| | | | | $t_j$ | [ms] | 8037 | 7837 | 7537 | 7037 | 6337 | 5537 | 4537 | 3737 | 2937 | 2337 | 1837 | 1337 | 937 | 637 |
| | | | | $\Delta t_j$ | [ms] | 200 | 300 | 500 | 700 | 800 | 1000 | 800 | 800 | 600 | 500 | 500 | 400 | 300 | |
| H89 | 330 | 14 | 175 | $Q_i$ | [kg] | 20 | 25 | 25 | 20 | 15 | 10 | 10 | 10 | 7.5 | 7.5 | 5 | 5 | 7.5 | 7.5 |
| | | | | $h_0$ | [m NN] | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 89 | 89.5 | 89 | 89 | 89 |
| | | | | dh | [m] | 16 | 16.5 | 17 | 13.5 | 10 | 8.5 | 8.5 | 7.5 | 6 | 7 | 6 | 5.5 | 7 | 7 |
| | | | 196 | a | [m] | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| | | | | $t_j$ | [ms] | 7825 | 7625 | 7325 | 6825 | 6125 | 5325 | 4325 | 3525 | 2725 | 2125 | 1625 | 1125 | 725 | 425 |
| | | | | $\Delta t_j$ | [ms] | 200 | 300 | 500 | 700 | 800 | 1000 | 800 | 800 | 600 | 500 | 500 | 400 | 300 | |
| H90 | 327 | 14 | 150 | $Q_i$ | [kg] | 20 | 25 | 20 | 15 | 10 | 10 | 7.5 | 7.5 | 7.5 | 7.5 | 5 | 5 | 5 | 5 |
| | | | | $h_0$ | [m NN] | 90 | 90 | 90 | 89 | 88.5 | 88 | 88 | 88 | 87.5 | 87 | 87 | 86.5 | 86 | 85.5 |
| | | | | dh | [m] | 16 | 17 | 10 | 9 | 8.5 | 8 | 6 | 6 | 6 | 7 | 5 | 5 | 5 | 5 |
| | | | 231 | a | [m] | 10 | 10 | 10 | 10 | 10 | 10 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | |
| | | | | $t_j$ | [ms] | 7613 | 7413 | 7113 | 6613 | 5913 | 5113 | 4113 | 3313 | 2513 | 1913 | 1413 | 913 | 513 | 213 |
| | | | | $\Delta t_j$ | [ms] | 200 | 300 | 500 | 700 | 800 | 1000 | 800 | 800 | 600 | 500 | 500 | 400 | 300 | |
| H91 | 322 | 14 | 107.5 | $Q_i$ | [kg] | 10 | 10 | 10 | 10 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 5 | 5 | 5 |
| | | | | $h_0$ | [m NN] | 90 | 90 | 90 | 90 | 89.5 | 89 | 88.5 | 87.5 | 87 | 86.5 | 86 | 85 | 84.5 | 84 |
| | | | | dh | [m] | 10 | 8.5 | 7 | 7.5 | 6 | 5.5 | 5 | 5.5 | 7 | 8 | 7.5 | 6 | 5.5 | 5 |
| | | | 226 | a | [m] | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 15 | 15 | 15 | 15 | 15 | 15 | |
| | | | | $t_j$ | [ms] | 7401 | 7201 | 6901 | 6401 | 5701 | 4901 | 3901 | 3101 | 2301 | 1701 | 1201 | 701 | 301 | 1 |
| | | | | $\Delta t_j$ | [ms] | 200 | 300 | 500 | 700 | 800 | 1000 | 800 | 800 | 600 | 500 | 500 | 400 | 300 | |

$Q_i$ - charge/deck, $h_0$ -Elevation of charge, dh -Material above charge, a - Distance between decks, $\Delta t_j$ - Timing between decks in a hole

$\Delta t_i$ … Timing between holes: H 91 - 212 ms - H 90 - 212 ms - H 89 - 212 ms - H 88

*Blasting Parameters Blast Group 17*

**Results**

Substantially the goal to move the water saturated sands into the lake was reached (Fig. 14 and Fig.15). Some small hills with escarpments, fractures and cracks remained quite behind the blasting area. No geotechnical issues influencing the stability of the slope could be recognized or measured. The sand masses were nearly completely flowing into the lake (Compare Fig. 14 and Fig. 15).

*Sand Mass (Arrow) Blast Group 3 before the blast*

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*Sand Mass (Arrow) Blast Group 3 after the blast*

Out of originally ca. 542.000 m³ sand to move, totally ca. 391.500 m³ could be moved into the lake. One positive byeffect of the blasts was, that ca. 2.000.000 m³ loose saturated sand deposits of not compressed masses, were excitated, liquefied, moved and finally compressed into stable conditions.

Mass induced Tsunami waves could be recognized. The amplitudes reached values of 0.2 – 0.4m (0.65 – 1.3 ft), measured on the lake. The measured vibrations for a charge weight of 30 kg (66 lb) per delay in 2375 m (2597yd) distance showed PPV`s in the size of 2.2 mm/s (0.086). The reason for nearly no attenuation was the water saturated environment which lead to wave dispersion.

For a further succesful application of the horizontal drilling technology in combination with blasting activities in similar projects, following facts are important:

- The Powder factor was 6…9 g/m³.
- The specific energy-density input based on the volume was 5…9 kJ/m³ (33…..60 cal/ ft³)
- The specific blastpower based on volume was 0.7…2.0 kW/m³.

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**Summary & Conclusions**

The rules for liquefaction and compression through blasting (Förster, 1992) in water saturated sands have been kept and linked together with the directional horizontal drilling technique.

The combination of a precise, horizontal drill hole over a length of 250m (820 ft) and a well prepared loading and blasting technique including electronic detonators resulted in the highest possible success.

Controlled liquefaction can be used to restore decommissioned lignite mine areas and to gain new safe and stable ground surface areas for buildings, leisure facilities and similar.

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*H. Krenn, Zueblin Inc., Austria/Canada*

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# Guaranteeing safety against firedamp and coal dust explosions for blasting operations in German coal mining


**ABSTRACT**

Coal mining in Germany makes use of about 400 t of explosives and about 700 000 detonators per year. Safety against firedamp and coal dust explosions is guaranteed through a number of measures: firstly, procedures are in place regarding blasting plans, measurement of methane, ventilation, and conduct during blasting. Secondly, the blasting unit is established as a specialised and independent section of the mining activity. And obviously the other measures include the exclusive use of permitted explosives, permitted
detonators and permitted blasting accessories, the latter as approved by German explosives law. The presentation will detail the German system for the classification of permitted explosives and detonators. In German coal mining only electric initiation is used. The safety of permitted electric detonators needs to be demonstrated by corresponding tests, and the test procedures will be presented. In addition, blasting accessories need to follow design principles, which take into account firedamp and coal dust explosion hazards. The latter also has to be proven by tests. Since the implementation of all these measures German
coal mining hasn't seen major accidents by firedamp or coal dust anymore.


**1 INTRODUCTION / GENERAL**

In present time in Germany coal mining is declining continously. The German government has plans to cease coal mining fully in near future. Nonetheless, coal mining still plays an important role and has been one of the economic factors of Germanys past economic development. As in many other countries engaged in coal mining, lessons had to be learnt and the reduction of fatalities in mining has always been a primary focus. From the 60ies to the 80ies of the past century there have been more than 100 explosions in mining of black coal. Not all of these involved fatalities, however, more than 30 explosions caused together almost 500 deaths, of which the Luisenthal event in 1962 with 299 fatalities was one of the biggest. The reasons for the explosions where generally sought in the insufficient safety of the explosives against firedamp and coal dust.

Development of permitted explosives, including detonators and equipment, has therefore been a continous effort in Germany, which in these days is coordinated by a sub-group called FABERG of the German Standardisation Insitute (DIN). A national standard for permitted explosives exists (DIN 20164) and a legal framework is set out in the German Explosives Act. In recent times fortunately, and due to the high safety level of permitted explosives, no accidents in the area of coal mining occurred anymore.

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Safety against firedamp and coal dust explosion is achieved in Germany by threefold measures: (1) only permitted explosives according to German standards may be used, (2) only permitted initiation systems may be used, and (3) blasters require a special training and following special rules for coal mining. The explosives themselves have to be tested according to German standards in explosive atmospheres and the explosives shall never ignite the methane-air-mixture and coal dust under test conditions.

## 2 STANDARDS AND RULES IN GERMANY

The rules and conditions for blasting in dangerous areas are in detail:

- only permitted explosives may be used, classes W I to W III
- rules for areas of use and athorised classes W I to W III depending on environment
- ventilation and CH4 measurement, permitted limit < 1%
- only approved blasting machines with electric pulse < 5 ms
- stemming only with water

In Germany three classes of permitted explosives are established, which are applied to blasting explosives and detonating cords, whereas for the detonators only a single set of parameters is fixed. The test conditions for safety against firedamp of the three classes are detailed in Table 1. An explosion chamber is needed with a volumen of approx. 10 m3 where a methane-air-mixture of 9 to 10 % of methane has to be present. Initiation has to take place with permitted detonators.

Table 1: Test conditions against firedamp

| Class of permitted explosive | Test conditions |
|---|---|
| W I | use of a steel mortar with a 55 mm diameter and 600 mm long borehole connecting its opening to the test chamber where the explosive atmosphere is prepared; length of charges shall be between 200 and 600 mm; no stemming; in total 10 tests to be done with no ignition of the atmosphere to occur |
| W II | use of a angle shot mortar with a minimum charge of 400 mm length; angle pointing upward and a impact plate 850 mm away; in 5 tests no ignition of the atmosphere to occur |
| W III | use of a angle shot mortar with a minimum charge of 1300 mm length; angle pointing to the side and a impact plate 150 to 300 mm away; in total 24 tests to be done with no ignition of the atmosphere to occur |

The test conditions for safety against coal dust explosion of the three classes are detailed in Table 2. An amount of 2 kg of coal dust must be dispersed into the air of an explosion chamber (approx. 10 $m^3$ inner volume) by use of 50 g of an explosive and a detonator, both obviously being already permitted in order not to initiate the coal dust prematurely.

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Table 2: Test conditions against coal dust explosion

| Class of permitted explosive | Test conditions |
|---|---|
| W I | use of a steel mortar with a 55 mm diameter and 600 mm long borehole connecting its opening to the test chamber where the coal dust is dispersed; length of charges shall be between 200 and 600 mm; no stemming; in total 10 tests to be done with no ignition of the coal dust to occur |
| W II | use of a steel mortar with a 40 mm diameter and 2000 mm long borehole connecting its opening to the test chamber where the coal dust is dispersed; length of charges shall be between 400 and 2000 mm; no stemming; in total 10 tests to be done with no ignition of the coal dust to occur |
| W III | use of a angle shot mortar with a minimum charge of 2000 mm length; angle pointing to the side and a impact plate 150 mm away; in 10 tests no ignition of the atmosphere to occur |

In addition a test is performed, to guarantee that the explosives used does not react in a deflagrative way. A steel tube is filled with cartridges of the explosive. Empty space is filled with coal dust. One end of the explosive is ignited with a ignition mixture consisting of Nitro-glycerine, Potassium Nitrate, and Ammonia chloride. The ignition shall only propagate into the tested explosive by not more than 2 cm. The steel tube is equiped with gas venting openings which are of different diameter for the different classes. Table 3 gives the permitted lengths.

Table 3: Safety against deflagration

| Class of permitted explosive | Venting diameter |
|---|---|
| W I | 5 mm |
| W II | 3.5 mm |
| W III | 2 mm |

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Figure 1 shows a picture of an explosion chamber according to German standards for the testing of permitted explosives. The angle shot mortar is shown in Figure 2. In the same Figure on the right side also the impact plate can be seen.

*Fig.1: Test facility for permitted explosives, today MAXAM in Sythen*

*Fig. 2: Angle shot mortar*

The above detailed classes of permitted explosives are linked to environmental conditions under which they shall only be used. Table 4 lists the conditions of operation and concentrations of firedamp and the classes.

Table 4: Use conditions for explosives in dangerous environments

| working environment | CH4 concentration in % | permitted explosive |
|---|---|---|
| rock mining without coal<br>(except upcasts) | up to 0.5<br>up to 1.0 | dynamite type<br>class W I |
| mining with coal seams | up to 0.3<br>up to 0.5<br>up to 1.0 | class W I<br>class W II<br>class W III |
| rises and dips, gate roads, coal faces and adjacent rock in areas near coal faces, upcasts | up to 1.0 | class W III |

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In the case of the danger of coal dust explosion the use of permitted explosives is not linked to any environmental parameters. The decision for one of the classes W I to W III is made on the basis of the firedamp conditions, and either class that has passed the test for coal dust can be used in view of preventing coal dust explosions.

Detonating cords are tested according to a separate German standard (DIN 20166) for permitted detonating cords. The test conditions are the same as for a W III explosive.

## 3 PERMITTED DETONATORS IN GERMANY

Permitted detonators are only tested for safety in firedamp. They are tested according to DIN 20165 in a test gallery equivalent to the one used for explosives. The methane concentration is the same. Ten detonators are tested one after the other within the same atmosphere. As a last test a non-permitted detonator is initiated and the ignition of the atmosphere checked. In the case that the atmosphere does not ignite, the test series is regarded invalid. For every delay time 50 detonators have to undergo successfully this testing. As a maximum 4 %, i. e. two of the 50 detonators may cause an explosion of the atmosphere.

The safety against firedamp is achieved by using for the shell material copper. The insulation and plug for the electric connections must be fire-proof. The flame of the detonation is reduced by additives and by limiting the secondary charge. Figure 3 shows the flame of the detonation for a regular detonator. In the second image boundary effects from fragments hitting the gallery wall can be seen. Figure 4 shows a similar sequence recorded with a permitted detonator. It is evident that the flame of the detonation is significantly smaller and no boundary effects occur.

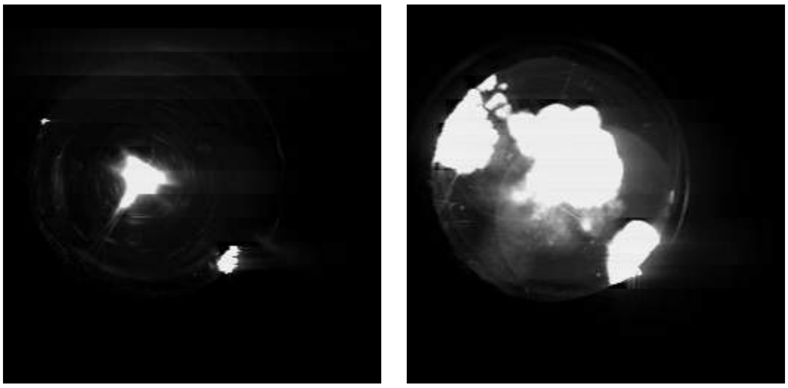

Fig. 3: Shot flames of a non-permitted detonator in firedamp, two time moments

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Fig. 4: Shot flames of a permitted detonator in firedamp, two time moments

## 4 CONCLUSIONS

Parameters and testing of permitted explosives are still fixed in Europe on a national basis. In 2001 the differences between the national testing regimes were found to be too differening to reasonably start a European standardisation process. If one considers the rules for detonators only, a European effort may not be that impossible. Table 5 shows some relevant parameters of permitted detonator testing.

Table 5: Use conditions for explosives in dangerous environments

| Test parameters | UK | F | CR | D | E |
|---|---|---|---|---|---|
| Volumina [$m^3$] | < 1(Container) | | 10 – 15 (test gallery) | | |
| $CH_4$ [vol.-%] | 9 | 8,5 ± 0,3 | 7,5 – 9,5 | 9,0 – 10,0 | 7,5 – 9,5 |
| Temperature [ C°] | - | - | - | 10 - 50 | 30 |
| Samples per delay | 200 | 20 | 50 | 50 | 50 |
| Acceptable probability of ignition [%] | ≤ 7 | ≤5 | ≤10<br>(95 % confidence) | ≤ 4 | ≤6 |

In Germany the safety standard for permitted explosives has proven to be very high. With this work we would like to encourage new efforts to unify the testing parameters for permitted explosives throughout Europe. This also plays an increasing role since use of permitted explosives is declining and the full engagement of a single country in this area may be economically problematic.

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**REFERENCES**

DIN 20164 Sprengmittel - Wettersprengstoffe, 2007, DIN Deutsches Institut für Normung, Beuth Verlag GmbH, 10772 Berlin

DIN 20165 Sprengmittel - Schlagwettersichere Sprengzünder, 2010, DIN Deutsches Institut für Normung, Beuth Verlag GmbH, 10772 Berlin

DIN 20166 Sprengmittel - Schlagwettersichere Sprengschnüre, 2012, DIN Deutsches Institut für Normung, Beuth Verlag GmbH, 10772 Berlin

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## Progress in PECCS project

PECCS - Pan-European Competency Certificate for Shotfireres / Blast designers by European Federation of Explosives Engineers

The project is being supported by EFEE and its 25 national European member nations. The project still awaits the propped European Union funding and continues to identify the right EU program for support.

The present plan and strategy, updated the on the 5th of November 2015, now moves the focus to the Swedish alternative. The plan is to apply for money from the Swedish Erasmus Plus programme. The BEF in Sweden, represented by Jan Johansson, Anette Broman and Viive Tuuna the PECCS manager, will prepare and present an application before the end of March 2016

We still have 8 partners: from Sweden, Germany, France, Portugal, Czech, United Kingdom, Estonia and Norway. All the partners have been a great support for the Estonian project manager Voglers Eesti, and for that we would like to thank them. As you can see, regardless of the negative answer, we have still not given up. We are hopeful that the application in the Erasmus program will be approved.

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In short the money will provided for:

- test training
- finishing the existing material
- adding exams and exercises
- finishing a Guidebook for teachers and self learners
- establishing a first version of an internet learning platform

Working together from different parts of Europe, we are positive to achieve our very important goal. We will keep you informed of the progress and share the news.

*Johan Finsteen Gjødvad, President of the EFEE board*

*Anette Broman, BEF Sweden*

*Viive Tuuna, PECCS project manager*

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# EFEE has new National Association Member - Romanian Association of Explosives and Blasting Engineering

European Federation of Explosives Engineers (EFEE) has received on 23rd of September 2015 application for National Association Membership from the newly established Romanian Association of Explosives and Blasting Engineering (abbreviation ARDE). Board of EFEE has approved this application on its meeting held in Barcelona on 25th of September. It does not happen so often that we welcome new National Association Member in EFEE therefore we would like to present our new member.

In Romania was missing a National Association unifying explosive users, blasters and blasting engineers. The idea to establish Romanian Association appeared in autumn 2010. It took a long time to form this association. Starting with 30th of July the Romanian Association of Explosives and Blasting Engineering is considered formally registered by legal authorities and acts in accordance with its Statute. The aims of ARDE are as following:

- The Romanian Association of Explosives and Blasting Engineers (ARDE) is established and operates for the uniform representation of interests of its members in the non commercial relations between them and the central and local authorities in Romania as well as the international authorities, directly involved in the process of manufacturing, preparation, sales and use of industrial explosives, for joining the main operators in the field in Romania.

- Promotion of standardization and harmonization of training regarding explosives

- This includes preparation of standard requirements for training on conducting blasting work: underground mine blasting, surface mine blasting (cast mining), and special blasting work such as blasting for demolition, underwater blasting, blasting in forestry and agriculture, ice and frozen land blasting etc.

- Supports all efforts of EFEE (European Federation of Explosives Engineers) regarding the issuance of a European certificate of authorized blaster, including partnership with EFEE and other affiliated National Associations to attract European funds for this purpose.

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• Develop and implement a national and international information system with regard to explosive engineering programs proposed by the Association to facilitate communication with the target group.

• Organize conferences, seminars, congresses, workshops, courses, in order to promote the work and the novelties in the field, including training courses in order to be authorized as a blaster.

The Association hopes to achieve these goals, as it seeks to improve the existing conditions of the market. We are encouraging the main actors pertaining to the explosive field to join the ARDE in the next period of time in order to become an active voice in the light of the future changes of national legislation expected in 2016.

More information about ARDE on the website: www.ar-de.ro

*Igor Kopal, Vice President of EFEE*
*Chairman of marketing and membership committee*

*Doru Anghelache*
*President, Romanian Association of Explosives and Blasting Engineering*

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## *Upcoming Events*

ISEE 42nd Annual Conference on Explosives and Blasting Technique January 31 –February 3, 2016
Las Vegas, USA
www.isee.org

World Tunnel Congress 2016
April 22-28, 2016
San Fransisco, USA
http://www.wtc2016.us/

24th World Mining Congress
October 18-21, 2016
Rio de Janeiro, Brazil
http://www.wmc.org.pl/?q=node/127

Wise words -"Become a Blaster and get stone rich!"

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# The 7th International Conference and Work shop on Explosive Education and Certification of Skills

Telford, Shropshire, UK, 14th April 2016


The EUExcert Association and the EUExImp partners are pleased to invite you to participate in the 7th International Conference on Explosive Education and Certification of Skills, to be held in Telford, Shropshire, UK at QHotels Golf Resort and Spa, on 14 April 2016.

## Objectives and targets

The overall objectives of the conference are to contribute to the harmonization of training and qualification of personnel in the explosives sector, for the development of a transferable certificate of Explosive Competences, through the discussion and sharing of knowledge, as well as experiences on the training and procedure of accreditation of individual competencies. The conference addresses all people occupied and active in the sector of explosives (explosives, propellants and pyrotechnics) from Governmental Agencies, Education Institutions, Employers and Employees Societies, Public and Private Companies in Military and Civil areas.

## Background

The manufacture and use of explosives, propellants and pyrotechnics underpins a significant part of the European Union economic and industrial activity. An understanding of explosives science and technology and the competence to harness it is central to maintaining European explosives capability, national security and in sustaining a competitive European industry. Much of EU safety legislation calls for "competent people" in roles that affect safety. In the case of explosives, this will be in all stages of life, from the formulation of new explosives in the laboratory, through manufacture, storage, transportation, use and disposal. In 2002 the Copenhagen Declaration set up steps to improve transparency in competences and qualifications in vocational education, cooperation, mobility schemes, and integrated programs of study, training research. In 2008 by recommendation of the European Parliament and of the Council of 23 April the European Qualifications Framework (EQF) for Lifelong Learning

was established. In 2003 Sweden, United Kingdom, Norway, Finland and Italy started the pilot project EUExcert within the Leonardo Da Vinci programme to develop a comprehensive framework which describes and categorises the competences of all workers engaged in the manufacture or use of explosives. Later Germany, Portugal, Czech Republic, Lithuania, Latvia and EFEE joined the project. In 2008 EUExcert programme was expanded and a network was formed as EUExNet. In 2011 the European organisation "EUExcert Association" was founded to ensure the development of an organisation that can be responsible for continuing the work to develop a common European framework for competencies and setting up standards for learning outcomes and certification of education and training. National nodes have been established in ten European nations and more nations worldwide are keen to join the network to exchange and learn from best practice.
In 2014 a new project started EUExImp (European Explosives sector implementation of occupational standards). This Conference will focus and discuss the aims and outcomes of this project.

## Main Topics

Education and vocational training in explosives sector
Step-by-step guidance material aimed for use by the industry
Implementation of Occupational Standards
The assessment of competences in explosives
Competences in explosives

## Conference language

English

## Deadlines

Registration ends: 15th of March, 2016

## Registration fee

50 EUR

## Registration fee includes

Participation in the Conference, coffees and lunch

## Conference registration

Registration form will be available on the conference website
www.kcem.se

## Full programme

The full programme is expected to be available on
the EUExcert website by end January 2016

## Conference committee

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