EFEE NEWSLETTER

February 2017

In this edition:

Innovative method for the evaluation of professional risk during controlled demolition with explosives of civil use

Blast demolition of Murnau Highway Bridge

The assessment of electric detonators in terms of delays accuracy, according with European harmonized standards

... and much more!

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NEWSLETTER
February 2017

This Newsletter contains the above articles (Click on the headings to jump to the article)

We in EFEE hope you will enjoy the present EFEE-Newsletter. The next edition will be published in May 2017. 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.

Nigel Taylor, Chairman of the Newsletter Committee and the Vice President of EFEE

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Dear EFEE members, the president´s voice

It is the New Year 2017, which means a lot of new beginnings and some old ones which still need to be worked on. Doing something better certainly should feature on our list - of our New Year resolutions. Please let me wish to all of you - our National Associations, Corporate members, Individual members, Honorary members as well as to our so far one Student member, to have a good and successful year 2017. In this year our federation is heading to our most important event where I would like to invite you all, to our next 9th World Conference on Explosives and Blasting which will take place in Stockholm from 10th - 12th September 2017.

The EFEE World Conference on Explosives and Blasting has established itself as one of the most important international blasting events. It all started in year 2000 with 1st EFEE World Conference in Munich and after Prague 2003 it continues on regular basis with a 2 years period. All eight of our previous EFEE World Conferences with great success have proved to be really important events where we can mutually share our different experiences and skills. We expect - the EFEE 9th World Conference on Explosives and Blasting to be as successful as our previous World Conferences and will attract participants and delegates not only from Europe but also from all over the world. The Conference is organized in cooperation with the Swedish national association - Swedish Rock Construction Committee (Bergsprängningskommittén).

Stockholm is the cultural, medial, political, and economical centre of Sweden. It hosts the annual Nobel Prize ceremonies and banquet at the Stockholm Concert Hall and the Stockholm City Hall. The earliest written mention of the name Stockholm dates from 1252, by which time the mines in Bergslagen made it an important site in the iron trade. Stockholm is located on Sweden's south-central east coast, where the freshwater Lake Mälaren — Sweden's third largest lake — flows out into the Baltic Sea. The central parts of the city consist of fourteen islands that are part of the Stockholm archipelago. Over 30% of the city area is made up of waterways and another 30% is made up of parks and green spaces. The city's oldest section is Gamla stan (Old Town), located on the original small islands of the city's earliest settlements and still featuring the medieval street layout. Stockholm is one of the cleanest capitals in the world. The city was granted the 2010 European Green Capital Award by the EU Commission; this was Europe's first "green capital".

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The most important fact which has to be highlighted in relation to our Conference - is that on 21st of October 1833 Alfred Bernhard Nobel, the Swedish chemist, engineer and innovator, worldwide known for inventing the dynamite was born in Stockholm. During the Conference the participants and their spouses can choose within various options which include attractive Stockholm for sightseeing and the visit of different interesting places.

EFEE 9th World Conference on Explosives and Blasting 2017 will take place at the Brewery - Conference Centre Stockholm a short walking distance from city centre. The venue offers unique conference room and halls, is bright, spacious and modern with excellent loading and logistic possibilities coupled with great interior structural design, which enables a natural flow for the participants. During breaks, participants can enjoy some fresh air out on the 40-meter long terrace or just savour the breath-taking panoramic view of the city centre of Stockholm and the sparkling waters surrounding it. Experiences like these really confirm the feeling of being in one of the best conference spaces in Stockholm. The Conference will start on Sunday 10th September with registration, workshop and welcome reception and will continue on Monday 11th of September and Tuesday 12th of September, with technical sessions and exhibition. The Gala dinner is planned for Monday evening and will take place at Winterviken in former Alfred´s Nobel factory. Which is a superb building that dates back to 1891 with wooden beams and classic features will host this event. In accordance with experiences from our previous eight Conferences we expect attendance over 450 delegates and professionals from over 50 different countries with a large industry exhibition. This will enable to create really unique forum for meetings and discussions of professionals from tunnelling, construction, demolition, quarry as well as mining industry. We have to share everything new and good experiences - as well as bad experiences to avoid mistakes in the future and improve the techniques. It applies to all of us - explosives end-users, manufactures, drilling and blasting operators, consultants, contractors, university people and state authorities.

Finally please let me point out one more time the importance of EFEE 9th World Conference on Explosives and Blasting and I´m really looking forward to meet you all in Stockholm from 10th - 12th September 2017. For more detail information as well as for conference registration please visit the website www.efee2017.com.

Please do not finish reading our Newsletter with my foreword but kindly continue to read - all the interesting articles are prepared especially for you in this Newsletter.

Igor Kopal, President of EFEE
www.efee.eu

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EFEE

9th WORLD CONFERENCE
THE BREWERY,
STOCKHOLM, SWEDEN

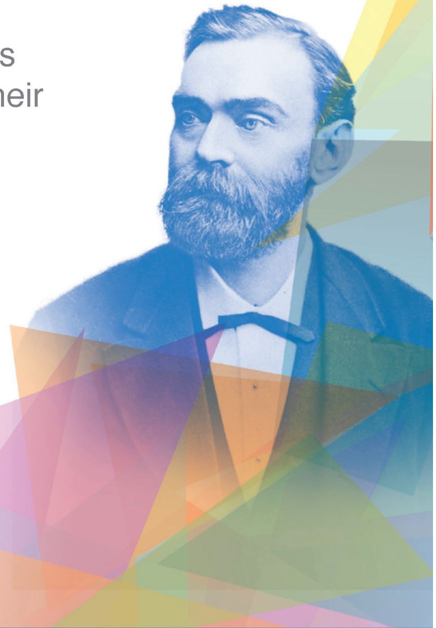
BERG SPRÄNGNINGSKOMMITTÉN

STOCKHOLM 2017

10th – 12th September

The World Conference on Explosives and Blasting is an excellent platform for becoming familiar with the current developments in the blasting sector.

Stockholm provides an excellent arena for experts from all over the world to extensively exchange their experiences in the home of Alfred Nobel.



The conference includes:

- Large Industry Exhibition
- Technical Programme Featuring
  - Blast vibrations
  - Explosives
  - Blasting experiences.
  - Demolition etc
  - Instrumentation
- Partner Programme
- Industry Specific Workshops
- Gala Dinner at Alfred Nobel's Factory

Important Dates:

- Call for Papers - Abstract Deadline Friday 10 February 2017
- Early Bird Registration - February to July 2017

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INNOVATIVE METHOD FOR THE EVALUATION OF PROFESSIONAL RISK DURING CONTROLLED DEMOLITION WITH EXPLOSIVES OF CIVIL USE

Adapted from Environmental Engineering and Management Journal

September 2016, Vol.15, No.9, http://omicron.ch.tuiasi.ro/EEMJ/

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Abstract

This paper presents an analytical approach to the evaluation concept of professional risk specific to activities of controlled demolition with civil use explosives of industrial/ civil objectives, ensuring the appropriate level of safety to the effects generated by performing blasting to these types of constructions. The scientific research highlighted in this article was obtained during Project PN 7:45 1:28 from The National Programme for Research and Development CORE/2014. The main purpose of evaluating occupational risk is to prevent the likelihood of injury and occupational disease and when there is no possibility to eliminate this risk, it is mandatory to reduce it up to the amount of residual risk which must be adequately controlled.

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Introduction

The Legislation forces employers to take all measures in order to prevent workers exposure to multiple risks which could cause accidents or professional disease. Thereby, methodological Regulations for applying Health and Safety Law no. 319/2006 regulates the mechanism that the employer must use to prevent an increase of these risks.

Each industrial branch generates specific risks that must be realized both by the employer and workers. On demolition works performed by authorized companies, using explosives, there are different types of risks, that can be found on construction sites and at the same time the risks involved in working with explosive materials (Covello et al., 1993; Conte, et al., 2011).

In many situations, on the same site, at least two companies are involved in the demolition works, for example a general contractor, a sub-contractor who brings and uses the special equipment required on the site, and the authorized company hired for blasting works. Each company is required, according to the law, to organize its own activity for prevention and protection, but at the same time all companies have to work together, collaborate and create a plan in order to realize and avoid the risks that could be generated by each company and create difficulties for the others. Besides the employees working on the site, there must also be considered the risks that could affect other persons exposed, living in the vicinity of the demolition area. Inside a working system, the general obligation of an employer is to ensure workers health and safety. An evaluation process of professional risks, giving the possibility to establish proper measures of prevention, protection and insurance for avoiding accidents and professional disease, informing employees and implementing an efficient system for professional safety management (Cruz, 2004; Risk Management Guidelines, 2011; Smid, 2001).

The main reason for evaluating professional risks is to prevent the accidents and professional disease; when the elimination of these risks is not possible, it is required to reduce their level to the value of residual risk when this can be adequately controlled. During the evaluation process of professional risks and also along the implementation of multiple safety measures, a special attention must be directed to the possibility that the professional risk might not be moved from one area to another of the work system. The technical and organizational solutions adopted in order to decrease or eliminate these risks must not create additional situations.

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From a structural point of view, the main stages of evaluating the professional risks are: identification of dangerous situations causing accidents and professional disease; identification of persons exposed to these dangerous situations; estimation and assessment of professional risks; studies for finding possibilities to eliminate professional risks; opportunity and necessity analysis for decreasing the need to adopt additional measures for eliminating the occupational hazards (CPCCDE 3016A, 2014; Pollution Prevention Guidelines, 2012; Programme – Based Engagement, 2009).

The assessment methodology for professional risks has two essential requests in this area:

- the evaluation procedure must be able to analyze all dangerous situations, possible accidents and professional disease, whatever their manifestation (obvious or potential dangers);

- elimination, if possible, of all risk of injury and professional disease, identified during the evaluation process.

The structure of the assessment process is presented below:

- identification of all factors of accidents risk and professional disease from the analyzed work system;
- identification of all persons exposed to injury and professional disease;
- estimation of professional risks;
- establishment and adoption of decisions regarding the new applicable measures for elimination and reduction of professional risk;
- analyze the prevention measures adopted to establish the order of their application;
- subsequently undertaken actions in the evaluation process;
- risk evaluation represents a permanent preoccupation for all the leading personnel of a company, from the beginning of a project, continuing with preparatory works, demolition works and monitoring their effects on human health and safety, the integrity of materials and goods and also effects of environment (Macdonald et al., 2000).

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Materials and methods

The development of blasting works and demolition of civil and industrial constructions, for certain affected buildings, involves different operations which could generate health and safety risks for the employees working in the company providing the project; also these operations could affect the vicinity of the site and the environment.

Graphical and analytical representation and assessment of professional risk on controlled demolition of industrial and civil objectives, using civil use explosives

The existence of risk in a work system appears due to the risk factors of injury and professional disease. Thereby, the elements which could properly characterize the risk are: the probability of an accident influenced by a risk factor and the severity of risk action consequences on the victim. Using both scales of probability and consequences severity of risk factor actions, each factor of risk from a system can be associated with characteristic elements, for each element having a certain level of risk (Fig. 2). From an analytical point of view, the system formed by six curves dividing the integral field of risk in seven distinct areas presented in Table 1 and represents the general solution of the differential equation (degree 2), with second differentiation order, and which variable is the gravity parameter g, (Eq. 1):

$$g'' + 0.28574\, g' + 0.020408\, g = 0 \qquad (1)$$

This equation can be solved based on the characteristic equation (Eq. 2):

$$r^2 + 0.2857\, r + 0.020408 = 0 \qquad (2)$$

which has a general solution (Eq. 3):

$$g_i = [c_{1i}(p+1) + c_{2i}]e^{-(p+1)r} \qquad (3)$$

g- variable of differential equation which defines the gravity parameter, (G);
p- variable of general solution g_i (where i=1,6 represents the index of risk curve i), which defines the probability parameter, (P);
r- variable of characteristic equation for solving the differential equation;
c_{1i}, c_{2i} - integration constant, determined from the initial conditions c_1 and c_2, corresponding to the curve of minimum risk.

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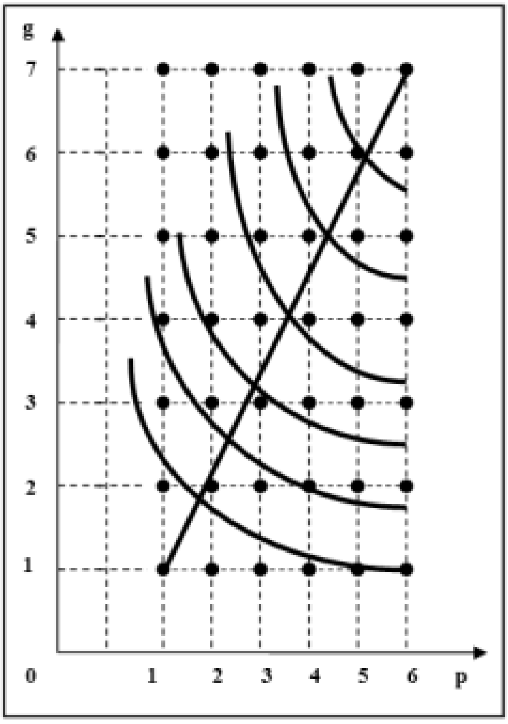
No. crt.	Name of equation	Equation
1.	Equation of minimum risk curve	$g1 = [(p+1) + 1]e^{-(p+1)/7}$
2.	Equation of low risk curve	$g2 = [-0.024965858\ (p+1) +0.716544186]e^{-(p+1)/7}$
3.	Equation of medium risk curve	$g3 = [-0.013377423\ (p+1) +0.537294492]e^{-(p+1)/7}$
4.	Equation of high risk curve	$g4 = [-0.010971558\ (p+1) +0.395512740]e^{-(p+1)/7}$
5.	Equation of very high risk curve	$g5 = [-0.019157306\ (p+1) +0.262815264]e^{-(p+1)/7}$
6.	Equation of maximum risk curve	$g6 = [0.004349399\ (p+1) +0.128874756]e^{-(p+1)/7}$

Table 1. Equations of risk curves

Considering the values of both integration coefficients, the general solution of the differential equation is (Eq. 4):

$$g_i = \left[\begin{bmatrix} 1.000000000 \\ -0.024965858 \\ -0.013377423 \\ -0.010971558 \\ -0.019157306 \\ -0.004349399 \end{bmatrix} (p+1) + \begin{bmatrix} 1.000000000 \\ 0.716544186 \\ 0.537294492 \\ 0.395512740 \\ 0.262815264 \\ 0.128874756 \end{bmatrix} \right] e^{-(p+1)/7} \quad (4)$$

Fig. 1. Curves of professional risk level



Normative regulations from most countries do not allow employers the achievement of critical standard. Thereby, generally, for each risk factor there are established either maximum limits in the form of values, in cases when factors manifestation could be characterized through measurable elements, or interdictions (factors which cannot be measured).

The respective regulations correspond to a maximum level of risk, which is different from a country to another, depending on the economic and social conditions.

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According to the specialized literature, the acceptable level of risk for our country is about 3.5 (22÷29), which actually requires an attitude in relation to the potential risk , mainly characterized by measures to monitor and control dangerous situations manifestation of risk factors (Moraru et al., 2002; Pece, 1997). That means in the first place that the operating permit of the economic agents, from environmental point of view, should be issued only if the risk evaluation on workplaces confirms the acceptable level; this fact should be demonstrated even by an analyze and reduction of evaluated risk found in the unacceptable area; their normalization is developed by applying proper measures for prevention and protection.

Analysis and reduction of professional risk on controlled demolition of industrial/civil objectives, using civil use explosives

In cases of evaluated risks situated in unacceptable areas, it must be applied and analyze and reduction procedure, by applying a suitable program of technical and organizational measures, in order to prevent the causes of unexpected events production (working accidents and/ occupational disease, also the effects of demolition on the vicinity of sites) (Lee et al., 2012; Murè et al., 2006; Nor Rizman Bin Abas, 2010).

In this case, it is used "the professional risk analyzer" (presented in Fig. 2), which was built based on the provided grids with value classes corresponding to the following parameters: the probability of producing an unexpected event, P presented in Table 3 and the gravity of maximum consequences, G presented in Table 2. In the following, there are introduced the grids correspondent to the parameters of health and safety at work, respectively P, G and R/S and the scale of attitude towards the level of professional risk presented in Tables 4 and 5 (Waddell and Burton, 2001). If after the risk assessment of workers health and safety on controlled demolition of industrial/ civil buildings using civil use explosives, it is identified a hazard for which it has been evaluated an unacceptable risk situation, it risk will be :

- highlighted in the index to risk records through the corresponding risk factor (Table 6);

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- completed a form of analysis and reduction of professional risk and it will build a diagram of risk reduction (Table 7 and Fig. 2) (Construction Phase Plan - Demolition, 2011).

Classes of severity	*Consequences*	*Severity of consequences G*
1	**Negligible**	Consequences minor unable to work up to 3 days (healing without treatment)
2	**Small**	Consequences minor unable to work up to 3 – 45 days, that need of medical treatment
3	**Averages**	Reversible consequences with a predictable work incapacity between 45 – 180 days, requiring medical treatment and hospitalization
4	**High**	Irreversible consequences, with a decrease of working capacity of 50%, the individual being able to provide a professional activity (disability grade III)
5	**Serious**	Consequences 100% irreversible, loss of labour capacity but with the possibility of self-service and spatial orientation (disability grade II)
6	**Severe**	Irreversible consequences with total loss of ability to work, the self-conduction or spatial orientation (disability grade I)
7	**Maximum**	Death

Table 2. The grid of the gravity parameter of maximum consequences

Classes of probability	**Events**	**The likelihood of consequences P**
1	**Extremely rare**	**(extremely low), P > 10 years**
2	**Very rare**	**(very low), 5 years < P < 10 years**
3	**Rare**	**(low), 2 years < P < 5 years**
4	**Less frequent**	**(average), 1 year < P < 2 years**
5	**Frequently**	**(high), 1 month < P < 1 year**
6	**Very frequently**	**(very high), P < 1 month**

Table 3. The grid of the probability parameter of producing an unexpected event, P

Levels of risk / safety	Risk assessment values R	Appreciation level of professional risk	Appreciation level of occupational safe ty
1 / 7	1 ÷ 7	Minimum risk	Maximum security
2 / 6	8 ÷ 13	Very small risk	Very high security
3 / 5	14 ÷ 21	Low-risk	High security
4 / 4	22 ÷ 29	Medium risk	Medium security
5 / 3	30 ÷ 35	High-risk	Small security
6 / 2	36 ÷ 39	Very high risk	Very small security
7 / 1	40 ÷ 42	Maximum Risk	Minimum security

Legend:

Represents the field of acceptable risk

Represents the field of unacceptable risk

Table 4. The assessment grid of professional risk level

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Levels of risk	*Appreciation level of professional risk*	*Attitude towards the professional risk*
1	**Minimum risk**	No special action is taken
2	**Very small risk**	
3	**Low-risk**	
4	**Medium risk**	Shall be made the monitoring of dangerous situations, event control of risk factors, additional corrective measures can be applied taking into account the cost-effectiveness
5	**High-risk**	Efforts will be made to reduce the level, but the costs of prevention should be carefully measured. Measures to reduce the risk level is implemented strictly determined period of time. Where is associated with greater risk of serious consequences, should be set exactly the probability of manifestation of risk factors responsible, and measures will be taken to mitigate them.
6	**Very high risk**	Activities can not continue until the risk is not reduced. Resources should mitigate the risk. At occurrence of other risks in the work, take immediate action.
7	**Maximum Risk**	Activities can not start until the risk is not reduced. If not immediately possible to decrease the level of risk, then work in this environment is PROHIBITED!

Table 5. Scale of attitude towards professional risk

No. Doc	**Description of occupational risk factors identified the concrete form of manifestation**	**Workplace (subsystem)**
1.	Professional risk generated by the preparatory works.	″Coș de Fum - Zlatna″
2.	Professional risk generated by the execution of blasting works.	

Table 6. Index of professional risk records

Experimental

For applying the innovative methodological instrument on the demolition achieved by blasting combined with classical works of the objective ″Cos de Fum – Zlatna″, presented in Table 7, the following steps were taken (NUCLEU Project, 2014):

I. The general information on the objective subjected to demolition, from the documentation sent to INCD INSEMEX Petrosani for approval, which was developed by SC WEST OGS IMPEX SRL Timisoara, named Demolition achieved by blasting combined with classical works of the objective Cos de Fum – Zlatna ;

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Table 7. Form for analysis and risk reduction in professional controlled demolition of the industrial / civil with explosives for civil uses

<table>
<tr><td colspan="6">ANALYSIS AND PROFESSIONAL RISK REDUCTION</td></tr>
<tr><td colspan="6">Economic agent: SC WEST OGS IMPEX SRL
Headquarter: Timisoara/Romania
Workplace (subsystem): ″Cos de Fum – Zlatna″</td></tr>
<tr><td colspan="2">Document no. 1</td><td colspan="2">Risk: Medium</td><td colspan="2">Level: 4</td></tr>
<tr><td colspan="6">1. Professional risk generated by the preparatory works.</td></tr>
<tr><td rowspan="2">Hazard, determined: Injury or disease of personnel during the preparatory works for controlled demolition of constructions using explosives.</td><td>P</td><td>G</td><td colspan="2">Estimate / risk assessment R</td></tr>
<tr><td>5</td><td>3</td><td>22</td><td>Medium</td></tr>
<tr><td colspan="6">Identification of potential risk factor: $R_{ig}(p_i,g_i)=(\sum r_iR_i)/\sum r_i \rightarrow R_{ig}(5,3)=22$, i=1,10 (Medium risk)
F1. Improper condition of access routes: $R_1(p_1,g_1)\rightarrow R_1(5,5)=33$
F2. Unprotected/deteriorated electrical plant: $R_2(p_2,g_2)\rightarrow R_2(2,7)=29$
F3. Obstacles present on the evacuation routes: $R_3(p_3,g_3)\rightarrow R_3(6,3)=23$
F4. Falls from height: $R_4(p_4,g_4)\rightarrow R_4(1,7)=21$
F5. Objects falling from height: $R_5(p_5,g_5)\rightarrow R_5(1,7)=21$
F6. Lack of specific elements PSI: $R_6(p_6,g_6)\rightarrow R_4(5,3)=22$
F7. Dark/narrow spaces: $R_7(p_7,g_7)\rightarrow R_5(5,3)=22$
F8. Harmful and toxic environment: $R_8(p_8,g_8)\rightarrow R_8(5,3)=22$
F9. Environment with extreme or variable temperatures: $R_9(p_9,g_9)\rightarrow R_9(4,2)=10$
F10. Improper lighting: $R_{10}(p_{10},g_{10})\rightarrow R_{10}(4,2)=10$

Description of the risk factor identified concrete form of manifestation:
- The affecting of stability and solidity of access routes
- Direct touching of electrical plant
- Obstruction of evacuation routes for personnel
- Usage of improvised devices or inadequate scaffold
- Lack of insurance or supervision of objects left on different heights
- Removal of elements regarding FSC
- Inadequate ventilation
- Presence of gas, steam, dust and noise
- High temperatures during summer time and low during winter time
- Limited and insufficient natural lighting
<u>Cause</u>:
- Performance of preparatory works for a controlled demolition of industrial/ civil constructions subjected for decommissioning
<u>Dysfunction</u>:
- Favoring the phenomenon of injury or professional disease as a result of exposure to the identified risks.</td></tr>
<tr><td>Technical and organizational measures possible:
<u>Technical measures</u>:
- Choosing safe walking routes
- Verification and decoupling of electrical plant from the network
- Verification of qualitative condition of air from the work environment
- Suitable work and PPE equipment
- Usage of proper equipment for measuring the quality of air from the work environment
<u>Organisational measures</u>:
- Proper training of personnel
- Business bureaucracy
- Proper coordination and allocation of personnel on jobs/ work posts</td><td colspan="5">References:

-Law 319/2006 for Safety and Health at work and the methodological implementing rules with further changes and additions
-Law 126/1995 re-published and the technical implementing rules
-Advised technical demolition documentation
-OHS instructions
-SR ISO 31000:2010 Risk management – Principles and guidelines</td></tr>
<tr><td rowspan="2">Residual hazard identification:
-Nature and configuration of constructions subjected to controlled demolition using explosives and the work environment related to it</td><td>P</td><td>G</td><td colspan="2">Estimate / risk assessment, R</td></tr>
<tr><td>4</td><td>3</td><td>17</td><td>Low</td></tr>
<tr><td>Residual risk:
-The Performance of preparatory works for a controlled demolition of constructions using explosives, in terms of compliance of the organizational and technical measures specified above.</td><td colspan="5">Actions:
Reduction of risk from value 22 (medium risk) to value 17 (low risk), by applying organizational and technical measures.</td></tr>
</table>

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Diagram of professional risk reduction

Severity class " G " / Probability classes P "	1 ↓	2 ↓	3 ↓	4 ↓	5 ↓	6 ↓
7 →	21	29	35	39	41	42
6 →	20	28	34	37	38	40
5 →	19	26	27	32	33	36
4 →	13	18	24	25	30	31
3 →	11	12	16	← 17	← 22	23
2 →	7	8	9	10	14	15
1 →	1	2	3	4	5	6

Document no. 2	**Risk: High**	**Level: 5**		
2. Professional risk generated by the execution of blasting works.				
Hazard, determined: Injury or disease of personnel during the blasting works for controlled demolition of constructions using explosives.	**P**	**G**	**Estimate / risk assessment R**	
	5	4	30	High

Identification of potential risk factor: $\mathbf{R_{ig}(p_i,g_i)=(\sum r_iR_i)/\sum r_i \rightarrow R_{ig}(5,4)=30,0}$ **(High risk)**

F1. Improper use of explosives: $R_1(p_1,g_1)\rightarrow R_1(3,7)=35$

F2.Presence of energy sources, open fire, thunder, electromagnetic field: $R_2(p_2,g_2)\rightarrow R_2(3,7)=35$

F3. Lack of possibility to keep separate (in different storage spaces) the disruptive explosives and the initiation resources: $R_3(p_3,g_3)\rightarrow R_3(2,7)=29$

F4. Falls from height: $R_4(p_4,g_4)\rightarrow R_4(2,7)=29$

F5. Objects falling from height: $R_5(p_5,g_5)\rightarrow R_5(2,7)=29$

F6. Improper correlation or mismatch of work charge with qualified human potential: $R_6(p_6,g_6)\rightarrow R_6(3,6)=34$

F7. Incorrect execution of loading operation and achievement of the initiation circuit: $R_7(p_7,g_7)\rightarrow R_7(2,7)=29$

F8. Appearance of misfires and their elimination: $R_8(p_8,g_8)\rightarrow R_8(3,7)=35$

F9. Noise produced by performing blasting operations: $R_9(p_9,g_9)\rightarrow R_9(5,3)=22$

F10. Uncontrolled detonation (inside the initiation grids) on the use of detonated electric staple with low intensity, in the presence of foreign electric sources: $R_{10}(p_{10},g_{10})\rightarrow R_{10}(2,7)=29$

F11. Network interruption or the failure to initiate the charges from the holes, on the use of detonating fuse with reduced linear charge: $R_{11}(p_{11},g_{11})\rightarrow R_{11}(2,7)=29$

F12. Appearance of partial misfires as a result of delayed detection of fitting mistakes, in cases of using non-electric elements: $R_{12}(p_{12},g_{12})\rightarrow R_{12}(2,7)=29$

F13. Accidental detonation of explosive residues remained unexploded during the charge of rubbish (manually or mechanically): $R_{13}(p_{13},g_{13})\rightarrow R_{17}(2,7)=29$

F14. Illicit pernancy by the unauthorized personnel of the rest of unexploded material: $R_{14}(p_{14},g_{14})\rightarrow R_{14}(2,7)=29$

Description of the risk factor identified concrete form of manifestation:

-Lack of measures or ineffective measures for restricting the access to the blasting area
-Close distances towards the residential area
-Storage of explosives in improper conditions before the performance of blasting works
-Lack of lightning conductor and grounding ring for the explosive deposits
-Inadequate location of temporary storage deposits in the job site
-Usage of improvised devices or inadequate scaffold
-Lack of insurance or supervision of objects left on different heights
-Inadequate allocation of work tasks in relation to the training and potential of personnel

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-Tiredness installed in different stages of the loading operation and performance of blasting network
-Performing additional operations required for clearing the misfire
-Inadequate control of work environment after blasting works
-Presence of gas, steam, dust and noise
-High temperatures during summer time and low during winter time

Cause:
-Performance of blasting works for a controlled demolition of civil/ industrial constructions subjected for decommissioning
Dysfunction:
-Favoring the phenomenon of injury or professional disease as a result of exposure to the identified risks.

Technical and organizational measures possible:	**References:**
Technical measures: -The compliance of working technology found in the technical documentation for the advised demolition -Respecting OHS instructions Organizational measures: -Proper training of personnel -Business bureaucracy -Proper coordination and allocation of personnel on jobs/ work posts	-Law 319/2006 for Safety and Health at work and the methodological implementing rules with further changes and additions -Law 126/1995 re-published and the technical implementing rules -Advised technical demolition documentation -OHS Instructions -SR ISO 31000:2010 Risk management – Principles and guidelines

Residual hazard identification:	**P**	**G**	**Estimate / risk assessment R**	
-Nature and configuration of all remains resulted from demolition constructions through blasting.	4	3	17	Low

Residual risk:	**Actions:**
-Control of work environment after blasting works.	Reduction of risk from value 30 (high risk) to value 17 (low risk), by applying organizational and technical measures.

Diagram of professional risk reduction

Severity class " G " \ **Probability classes P "**	**1 ↓**	**2 ↓**	**3 ↓**	**4 ↓**	**5 ↓**	**6 ↓**
7 →	**21**	**29**	**35**	**39**	**41**	**42**
6 →	**20**	**28**	**34**	**37**	**38**	**40**
5 →	**19**	**26**	**27**	**32**	**33**	**36**
4 →	**13**	**18**	**24**	**← 25**	**← 30**	**31**
3 →	**11**	**12**	**16**	**↓ 17**	**22**	**23**
2 →	**7**	**8**	**9**	**10**	**14**	**15**
1 →	**1**	**2**	**3**	**4**	**5**	**6**

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Fig. 2. Matrix of professional risk assessment, built using numeric variables (matrix of professional risk analyzer)

Severity class " G"	1 ↓	2 ↓	3 ↓	4 ↓	5 ↓	6 ↓
	Probability classes P"					
7 →	21	29	35	39	41	42
6 →	20	28	34	37	38	40
5 →	19	26	27	32	33	36
4 →	13	18	24	25	30	31
3 →	11	12	16	17	22	23
2 →	7	8	9	10	14	15
1 →	1	2	3	4	5	6

II. Identifying the factors of professional risk based on predetermined control lists;

III. Estimation and assessment of occupational risk to evaluate the level of risk in both cases;

IV. The anaıysıs and reduction of professional risk that could be unacceptable;

V. The hierarchy of professional risk and the establishment of the appropriate measures for prevention and protection.

From the occupational point of view, the main risks unique to the demolition activities of ″Cos de Fum - Zlatna″ using civil use explosives are the professional risk generated by the preparatory works and execution of blasting works.

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Results and discussion

After the assessment of risk on the controlled demolition of Cos de Fum – Zlatna using explosives for civil uses were obtained the following results (Table 8).

Appraisal and assessment of professional risk on preparatory works	
Improper condition of access routes	$R_1(p_1,g_1) \rightarrow R_1(5,5)=33$
Unprotected/ deteriorated electrical plant	$R_2(p_2,g_2) \rightarrow R_2(2,7)=29$
Obstacles present on the evacuation routes	$R_3(p_3,g_3) \rightarrow R_3(6,3)=23$
Falls from height	$R_4(p_4,g_4) \rightarrow R_4(1,7)=21$
Objects falling from height	$R_5(p_5,g_5) \rightarrow R_5(1,7)=21$
Lack of specific elements PSI	$R_6(p_6,g_6) \rightarrow R_4(5,3)=22$
Dark/ narrow spaces	$R_7(p_7,g_7) \rightarrow R_5(5,3)=22$
Harmful and toxic environment	$R_8(p_8,g_8) \rightarrow R_8(5,3)=22$
Environment with extreme or variable temperatures	$R_9(p_9,g_9) \rightarrow R_9(4,2)=10$
Improper lighting	$R_{10}(p_{10},g_{10}) \rightarrow R_{10}(4,2)=10$
$R_{ig}(p_i,g_i)=(\sum r_i R_i)/\sum r_i \rightarrow R_{ig}(5,3)=22$ (Medium risk)	
Appraisal and assessment of professional risk on blasting works	
Improper use of explosives	$R_1(p_1,g_1) \rightarrow R_1(3,7)=35$
Presence of energy sources, open fire, thunder, electromagnetic field	$R_2(p_2,g_2) \rightarrow R_2(3,7)=35$
Lack of possibility to keep separate (in different storage spaces) the disruptive explosives and the initiation resources	$R_3(p_3,g_3) \rightarrow R_3(2,7)=29$
Falls from height	$R_4(p_4,g_4) \rightarrow R_4(2,7)=29$
Objects falling from height	$R_5(p_5,g_5) \rightarrow R_5(2,7)=29$
Improper correlation or mismatch of work charge with qualified human potential	$R_6(p_6,g_6) \rightarrow R_6(3,6)=34$
Incorrect execution of loading operation and achievement of the initiation circuit	$R_7(p_7,g_7) \rightarrow R_7(2,7)=29$
Appearance of misfires and their elimination	$R_8(p_8,g_8) \rightarrow R_8(3,7)=35$
Noise produced by performing blasting operations	$R_9(p_9,g_9) \rightarrow R_9(5,3)=22$
Uncontrolled detonation (inside the initiation grids) on the use of detonated electric staple with low intensity, in the presence of foreign electric sources	$R_{10}(p_{10},g_{10}) \rightarrow R_{10}(2,7)=29$
Network interruption or the failure to initiate the charges from the holes, on the use of detonating fuse with reduced linear charge	$R_{11}(p_{11},g_{11}) \rightarrow R_{11}(2,7)=29$
Appearance of partial misfires as a result of delayed detection of fitting mistakes, in cases of using non-electric elements	$R_{12}(p_{12},g_{12}) \rightarrow R_{12}(2,7)=29$
Accidental detonation of explosive residues remained unexploded during the charge of rubbish (manually or mechanically)	$R_{13}(p_{13},g_{13}) \rightarrow R_{17}(2,7)=29$
Illicit pernancy by the unauthorized personnel of the rest of unexploded material	$R_{14}(p_{14},g_{14}) \rightarrow R_{14}(2,7)=29$
$R_{ig}(p_i,g_i)=(\sum r_i R_i)/\sum r_i \rightarrow R_{ig}(5,4)=30,0$ (High risk)	

*Table 8***.** Results of risk assessment

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Conclusions

The execution of blasting of civil and industrial constructions for buildings which must be dismantled, involves a series of operations which generate risks in health and safety domain (both for the employees of the economic operator performing the project, and also for humans living in the vicinity and the environment).

From the occupational point of view, the main risks specific to the demolition of industrial/civil objectives using civil use explosives are the professional risk arising from the preparatory and blasting works. For the appraisal and assessment of risk on the demolition of industrial/civil objectives using civil use explosives, it has been designed an innovative methodological instrument for diagnosis and prognosis of professional risk specific to explosive activities.

This graphical analytical innovative instrument has as basis an analytical approach of the explicating concept of risk parameters, offering the possibility of listing the occupational risk (specific to demolition activities with explosives for civil use), both for evaluating levels, also in function by the position occupied within the same level. From the research performed on controlled demolition of the objective Cos de Fum , using civil use explosives, it can be appreciated that the obtained results clearly and objectively reflect the possibility to harm the workers engaged in hazardous activities and their health and safety.

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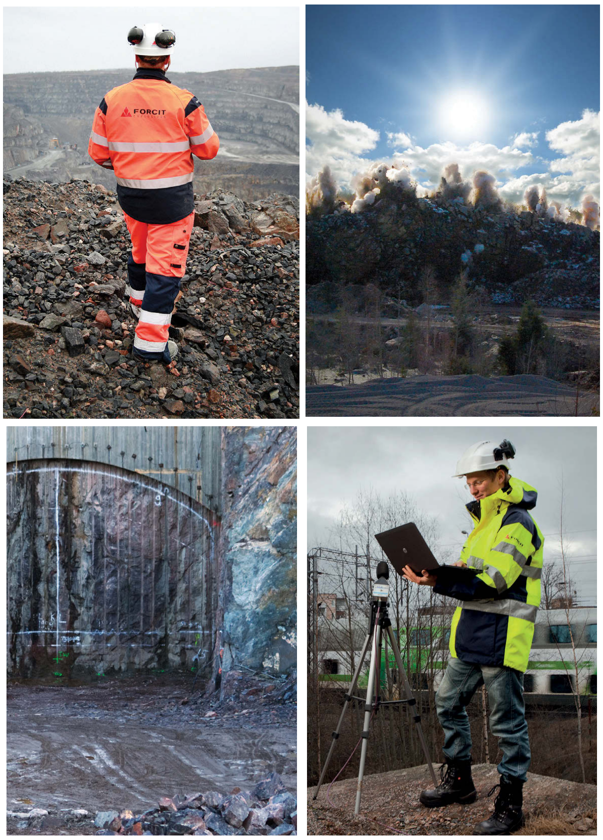

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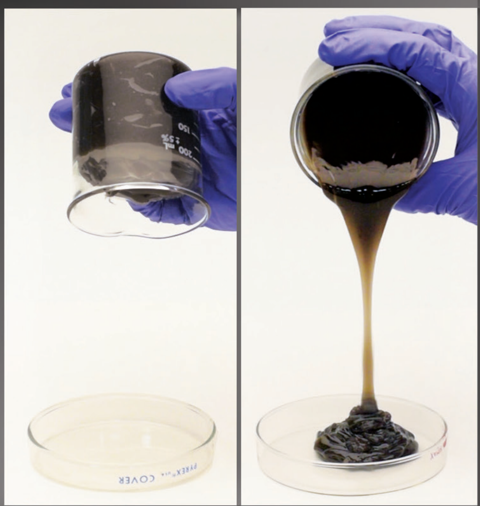

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THE ASSESSMENT OF ELECTRIC DETONATORS IN TERMS OF DELAYS ACCURACY, ACCORDING WITH EUROPEAN HARMONIZED STANDARDS

Abstract

Determination of the delay precision of the electrical detonators regarding the legislation in force and the applicable standards on field, ensure the conditions of garanty the safety characteristics of these kind of products. Applying procedured methodological instruments for testing and assessment of electrical detonators it is possible to evaluate the functioning (detonation) outside the range of the nominal succesion for neighbour delay number.

Generalities

For an explosive charge to detonate at a stable speed level, conditions in which maximum energy is release, it must be excited / initiated with a sufficiently high shock, this is the role of the initiation systems.

Currently are used only constructive types of detonators (fig.1), for initiating the explosive for blasting, this having the significant structural differences and time delays ranging from instant millisecond or the order of seconds. The delay is intrinsically (resulting from the constructive parameters) or the electronic detonators is programmable in a wide range, noting that this type of detonators involves significant costs.

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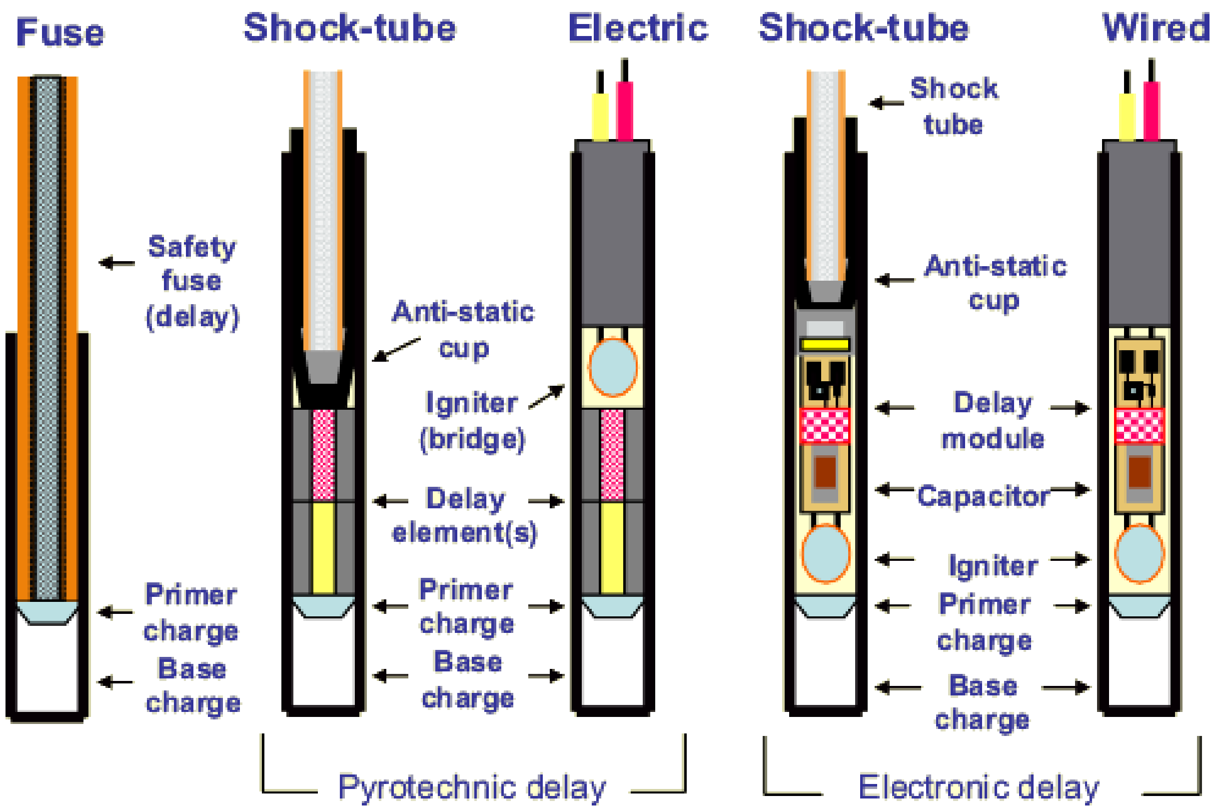

Fig.1. Constructive types of detonators for use in mining

European harmonized standards EN 13763-16 SR: 2004 and SR EN 13763-1: 2004 states from the technical point of view the technical method for testing, regarding the precision determination of electric detonators delay.

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The calculation algorithm on the accuracy of delay at the electric detonators

From a procedural standpoint, to determine the specific indicators to determine the precision of delay is required the following steps:

- Calculation of average time delay and the standard deviation (sk):

$$\bar{t}_k = \frac{1}{n_k}\sum_{i=1}^{n_k} t_{ik} \qquad (1.1)$$

$$sk = \sqrt{\frac{\sum_{i=1}^{n_k}(t_{ik}-\bar{t}k)^2}{n_k-1}} \qquad (1.2)$$

where: nk=30 represents the number of electric detonators which are test subjects for each stage of delay k=1÷10.

- The calculation of adjusted nominal delay time (tnom adj,k) and adjusted nominal time difference (Δtnom adj,k):

$$t_{nom\ adj,k} = t_{nom,k} + \frac{1}{4}(t_{nom,(k+1)} + t_{nom,(k-1)} - 2t_{nom,k}) \qquad (1.3)$$

where: tnom,k is the nominal delay time (in milliseconds) for the interval number k, indicated by the manufacturer with the operating instructions manual:

$$\Delta_{nom\ adj,k} = \frac{1}{2}(t_{nom,(k+1)} - t_{nom,(k-1)}) \qquad (1.4)$$

- Calculation of the largest and the smallest delay time (tnom adj,kmin și tnom adj,k max):

$$t_{nom\ adj,k\ min} = t_{nom,k} - \frac{1}{4}(t_{nom,(k+1)} - t_{nom,k}) \qquad (1.5)$$

$$t_{nom\ adj,k\ max} = t_{nom,k} + \frac{1}{4}(t_{nom,k} - t_{nom,(k-1)}) \qquad (1.6)$$

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- The calculation of factors ck:

$$c_k = \sqrt{2}\, Q_{Fk} = \sqrt{2}\left[\frac{\frac{1}{2}\Delta t_{nom\,adj,k} - (\bar{t}_k - t_{nominal\ limit,k})}{s_k}\right] \tag{1.7}$$

where: QFk is the quality factor for the number of interval k.

- Setting up the triangles of acceptance following the calculation of the essential points:
  - The height of the triangle, skmax (ms)

$$\frac{\Delta t_{nom\ adj,k}}{c_{min}\sqrt{2}} \tag{1.8}$$

  - The lowest point of the triangle, tiv (ms)

$$t_{iv} = t_{nom\ adj,k} - \frac{\Delta t_{nom\ adj,k}}{2} \tag{1.9}$$

  - The uppermost point of the triangle, tuv (ms)

$$t_{uv} = t_{nom\ adj,k} + \frac{\Delta t_{nom\ adj,k}}{2} \tag{1.10}$$

  - Triangle center, tc (ms)

$$t_c = t_{nom\ adj,k} \tag{1.11}$$

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Methodological and practical instructions for the testing accuracy, for determination of electric detonators delay

From the methodological point of view trying to determine the accuracy of delay is carried out on specimens consisting of a total of 30 electric detonators for each number of delay time, with the same chemical composition, charge, size and material of construction.

Equipment necessary to carry out the test, consisting of a **power source** capable of producing a continuous current according to the manufacturer specification **, a timer device** or **oscilloscope** to measure the time of delay required between starting the impulse and the impulse to stop, means, both for the start-up an impulse (trigger circuit to ensure an effective electrical pulse when the ignition current is applied), and to provide an impulse stop, the timer / oscilloscope (optical sensor or pressure sensor capable of providing an electrical impulse when the base charge is initiated, respectively the secondary load of the electric detonators) and a conditioning room capable of maintaining a temperature in the range from about $15 \div 30\ ^0C \pm 2\ ^0C$.

The procedure for testing these types of products, aiming a first stage conditioning them at least 2 hours before the test, at the temperature specified by the manufacturer, in the range from about $15 \div 30\ ^0C$, thereafter there follows the test phase, which must be made, in $\pm 2\ ^0C$ from the temperature conditioning .

After connecting and the introduction of the electric detonators, inside the stand they are initiated, and then record the individual delays and the number of missed ignitions (Figure No. 2, 3 and 4).

Fig.2. Stand for testing electric detonators as required by harmonized European standards

Fig. 3. Electric detonators prepared for testing

Fig.4. The measuring and command equipment for the stand for determine the precision of detonators delay

The case study

To determine the precision of delays, the millisecond electric detonators were made a number of attempts in the INSEMEX Polygon, with harmonized European standards SR EN 13763-16: 2004 and SR EN 13763-1: 2004.

After testing were obtained the following values of the delays (Table 1):

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Number of attempts n_{ki}, k=1,10 i=1,30	**The values of measurement delay times / of delay stage, to k=1,10**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Nominal time / Delay stage, (ms)									
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**
	The times of delay measured (ms), t_k									
1	32,10	58,50	81,37	119,84	139,54	166,31	182,06	221,93	261,02	266,49
2	35,08	52,85	73,50	110,72	142,81	168,18	220,07	196,30	247,54	268,22
3	38,48	59,16	76,93	118,38	137,77	167,70	207,25	133,03	**30,966***	271,09
4	34,75	62,67	81,45	110,38	139,39	160,70	180,38	**74,42***	255,37	259,86
5	33,42	52,70	77,00	109,73	135,65	178,16	186,37	**85,09***	253,87	259,66
6	32,21	52,35	76,50	106,28	134,28	173,79	**46,515***	226,73	224,83	263,25
7	31,42	52,78	75,40	114,06	**31,120***	160,18	**3721,29***	223,95	226,42	270,47
8	23,20	54,91	82,51	104,29	140,11	173,61	196,32	167,73	257,72	**108,97***
9	34,00	58,23	84,34	104,22	134,36	166,47	193,22	162,51	236,57	212,04
10	26,83	52,01	80,65	107,54	139,33	174,75	**2893,45***	221,26	247,59	**39,684***
11	24,22	54,54	73,42	109,80	145,27	173,93	197,74	176,21	224,15	262,72
12	24,61	50,54	79,70	106,31	142,84	170,83	172,39	217,25	235,57	268,84
13	32,13	56,16	79,55	107,60	146,40	176,96	199,49	219,34	233,04	249,82
14	25,05	54,58	73,80	110,48	141,39	176,12	201,27	102,74	221,11	259,60
15	32,81	55,89	70,80	**50,08***	133,86	175,83	176,65	227,98	232,97	**173,81***
16	30,04	55,85	82,20	103,94	136,18	176,75	**53,833***	233,67	226,06	262,71
17	31,43	50,32	90,30	109,04	140,34	177,75	188,09	241,33	233,87	278,95
18	35,80	55,93	81,00	122,58	141,36	170,75	188,39	**69,63***	216,88	261,81
19	32,56	54,21	79,55	106,30	133,19	171,75	179,96	231,91	231,37	**198,29***
20	33,03	53,75	88,00	115,42	135,15	166,16	184,13	**56,08***	246,24	259,55
21	30,64	51,46	77,52	109,86	133,45	174,44	190,40	138,31	248,08	247,73
22	29,60	57,86	95,20	103,57	**4034,40***	174,91	197,60	**57,72***	222,23	265,97
23	32,00	50,77	84,90	106,77	138,45	175,73	193,00	220,06	245,54	268,46

Table 1.

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24	33,62	55,64	84,00	116,85	134,20	165,07	**5589,99***	**114,9***	**5196,799***	277,12
25	27,81	57,38	76,82	107,26	130,55	168,25	196,00	**62,42***	**58,683***	**187,40***
26	25,62	56,95	85,39	106,47	131,12	173,32	194,31	**53,84***	225,89	277,10
27	33,61	56,67	80,75	103,84	146,11	174,64	193,10	19,53	251,36	264,02
28	34,63	55,11	80,54	103,19	124,41	175,23	194,73	228,46	251,80	**154,24***
29	31,78	49,21	83,90	108,20	133,67	174,54	192,45	146,67	225,83	228,74
30	25,69	48,53	78,00	106,00	138,34	173,15	194,85	191,24	224,54	**6564,44***

Note: *- exceptional values according SR EN 13763-16:2004

After statistical processing of the specific values of tests carried out resulted in the following synthetic indicators (table 2):

Result indicators		Delay stage, for k_i, i=1,30									
		1	2	3	4	5	6	7	8	9	10
		Nominal time/ Delay stage (ms)									
		30	60	90	120	150	180	210	240	270	300
		The times of delay measured (ms), t_{ki}									
The average of delay times, $t_{k\ med.,\ (ms)}$		30,939	54,7231	80,833	109,132	137,482	172,303	192,008	198,195	237,313	255,556
Standard deviation, s_k		3,885466	3,175094	4,992858	5,095756	5,066773	4,525412	10,02035	35,2432	13,08942	16,1223
Number of ignitions missed		0	0	0	0	0	0	0	0	0	0
$t_{Grubbslimit}$	Inf.	18,88	44,87	65,34	93,31	121,76	158,26	160,91	88,83	196,69	205,52
	Sup.	42,99	64,57	96,32	124,94	153,20	186,34	223,10	307,55	277,92	305,58
$t_{nominal\ limit}$	Inf.	15	45	75	105	135	165	195	225	255	285
	Sup.	45	75	105	135	165	195	225	255	285	300
Number of ''exceptional'' values		0	0	0	1	2	0	5	7	**3**	7
The factor, c_k		5,117857	4,330752	1,652406	1,146744	0,693003	2,282514 (c_{min}^*)	-0,42216	-1,0755	-1,91091	-9,2591
Nominal time of delay, $t_{nom,k}$		30	60	90	120	150	180	210	240	270	300

Table 2.

Note: *- the factor c_k minimum according to the standard SR EN 13763-1:2004

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Graphic-analytical representation of the results obtained through acceptance triangles (Figure No. 5) allows to highlight how compliance / non-compliance with the requirement applied, depending on the positioning of the points represented in the diagram whose coordinates are statistical parameters specific to each slot number, respectively average value and standard deviation.

Thus, the result located within the triangle of acceptance, afferent number of interval the requirement is considered fulfilled, otherwise ascertaining the failure to fulfill the requirement.

To configure triangles of acceptance was necessary to calculate the critical points whose values are shown in Table 3:

Parameters of triangles for acceptance										
Delay stage	1	2	3	4	5	6	7	8	9	10
The height	50,24	50,24	50,24	50,24	50,24	50,24	50,24	50,24	50,24	50,24
Lowest point	15,00	45,00	75,00	105,00	135,00	165,00	195,00	225,00	255,00	285,00
Uppermost point	45,00	75,00	105,00	135,00	165,00	195,00	225,00	255,00	285,00	150,00
Center	30,00	60,00	90,00	120,00	150,00	180,00	210,00	240,00	270,00	217,50

Table 3.

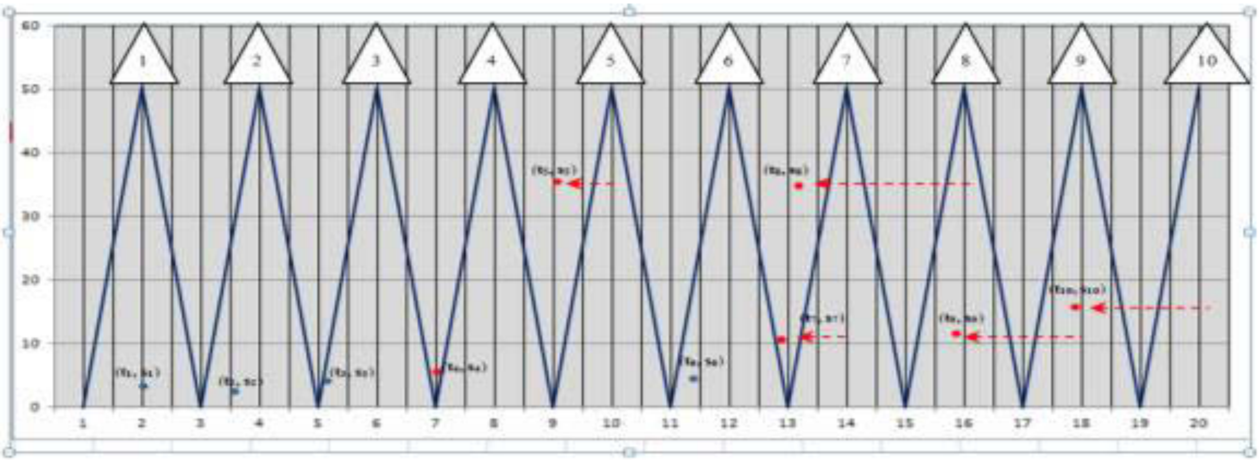

Fig.5. Graphical representation of acceptance triangles, to assess whether compliance / non-compliance to achieve the level of requirement applied

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From the analysis of the diagram can be seen in Figure No. 5 that for late stages 1, 2, 3 and 6 applied the requirement is met, in fact supported by positioning points inside the blue of the triangles corresponding of acceptance the delay involved and the delay stages 4, 5, 7, 8, 9 and 10 red points are located outside of the acceptance triangles, emphasizing while a displacement to the left thereof, which proves the existence of overlapping high probability of delay time over the interval numbers adjacent afferent or confirmation detonation outside the proposed sequence.

Conclusions

- The test for the determination of the accuracy of the electric detonators delay shall be made in accordance with the European harmonized standards EN 13763-1: 2004, in order to guarantee the security quality of such products;

- After statistical processing of the data obtained from measurements made with suitable equipment, such as: the average delay and standard deviation; nominal delay time adjusted and the nominal time difference adjusted; limits of the time interval delay, according to Grubbs test; ck factor, specific indicators are obtained by numerical results that can be quantified and valued by graphic-analytical triangles acceptance;

- The study case highlights in the test of the electric detonators recently tested at the INSEMEX Polygon, the graphic-analytical method for determining the probability of overlapping of the delay times over those afferent of interval numbers adjacent as confirmed by finding out the detonation sequence proposed for delay steps 4, 5, 7, 8, 9 and 10.

- Failure to fulfill of this functional parameter for the electric detonators may cause technical events that can result either with partial failures, or situations that may lead to cut of the connectors for holes loads or disturbing the pattern front. These technical incidents can generate considerable economic loss due to costs for their elimination or accidents resulting in human casualties.

Gabriel VASILESCU – PhD. Eng., Emilian GHICIOI – PhD. Eng., Attila KOVACS – PhD. Eng., Daniela RUS – PhD. Eng., Edward GHEORGHIOSU – PhD. Student, Eng., Ciprian JITEA – PhD. Student, Eng., Sorin BORDOȘ – Eng.

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EN 13763-1: 2004 „ Explosives for civil uses. Detonators and relays – Part 1 Requirements".

EN 13763-16: 2004 „ Explosives for civil uses - Detonators and relays - Part 16: Determination of delay accuracy".

Council Directive 93/15/EEC of 5 April 1993 on the harmonisation of the provisions.

Blast Demolition of Murnau Highway Bridge

The 59 m long highway bridge near Murnau (Bavaria) was demolished by blasting after a mechanical attempt failed. The simple principle of the blast operation was causing a vertical collapse by blasting all concrete pylons. The preparation and the execution of the blast operation are described.

The bridge

Fig. 1. Southern view of the bridge, neighbouring bridge behind Nachbarbrücke

Two parallel prestressed concrete bridges for both directions crossing highway A95 (Garmisch-Partenkirchen) near Murnau, Großweil interchange, had to be blasted within 8 months. They were of the same construction but had skew margins.

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Each four-field beam bridge was 59 m long and supported by 2 x 3 rectangular concrete pylons being 10 to 12 m high. The pylon cross-sections measured 1.0/1.2 m at the top and approx. 1.5/1.7 m at the bottom (fig. 1 - 4).

The solid rectangular bridge girder was pre-stressed length- and crosswise. The prestressing elements for the longitudinal prestressing were positioned like a clothesline: the "clotheslines" (27 prestressing elements in the 90 cm thick pad) "sag" in the concrete between the pylons and the abutments over spans of approx. 13 m (boundary spans) and of approx. 16 m (centre spans). The leading mass distribution of the bridge superstructure measured 26.7 t/m.

Surroundings

Except from the neighbouring bridge channeling all A95 traffic and having a spacing of 2 to 3 m between the lanes, no further protection requirements had to be taken into account. The old and the new bridge decks had more or less the same height. The centre to centre distance between the old pylon and the neighbouring new pylon measured approx. 9.5 m.
The slip road crossing below the highway was completely reconstructed later (fig. 1).

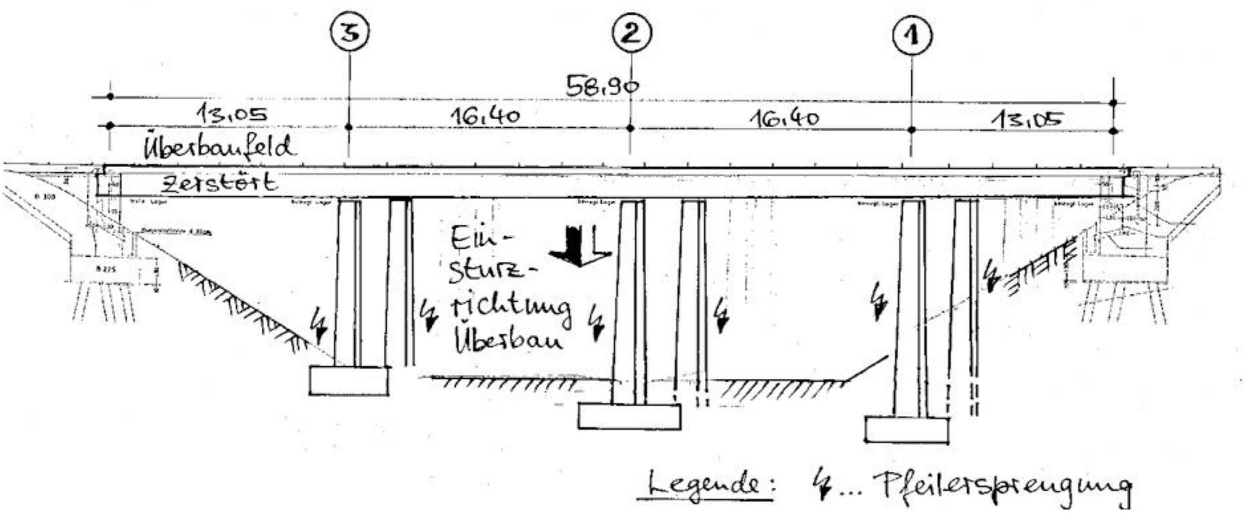

Fig. 2. View of the bridge

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Failed mechanical demolition of the southern bridge

Originally, the bridges were to be demolished mechanically. First, the lateral walkway cantilevers were removed. The remaining prestressed bridge pad could have been demolished smoothly from the side using a long-arm excavator. Instead, two conventional excavators were positioned on the bridge pad.

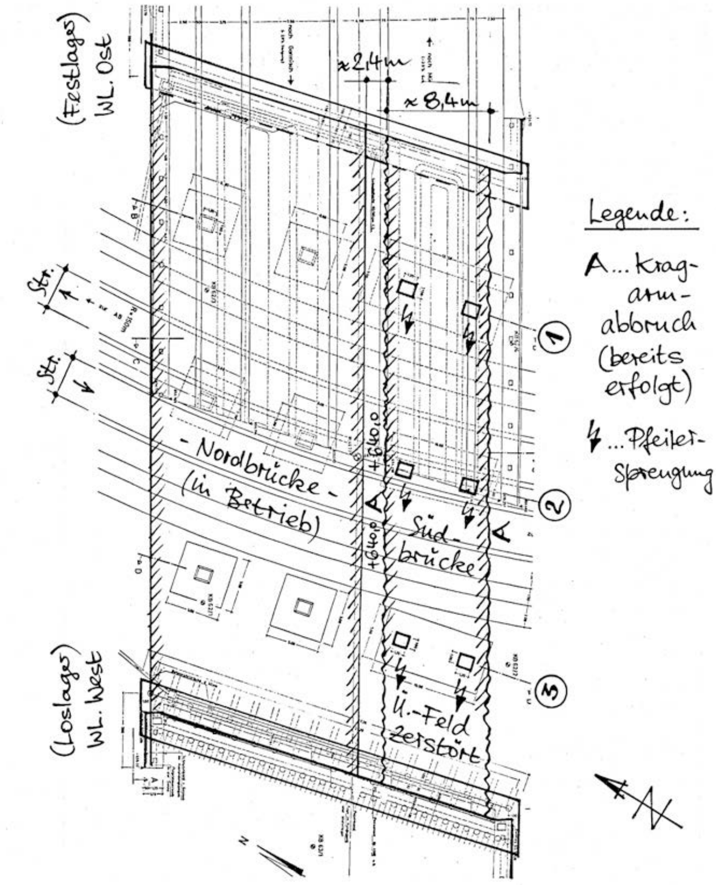

Fig. 3. bridge top view

Without additionally supporting the bridge, this would be like sawing off the branch one is sitting on. The excavator actually drilled predetermined breaking lines into the bridge pad in cross direction which consequently broke. Only the prestressed reinforcement prevented the skew bridge from crashing completely. Still, one excavator fell down 10 m from the side, the other one “only” toppled over on the skew bridge plate. The order to demolish the bridge by blasting was given right after this incident.

The blasting

The beam bridge supported by pairs of pylons could not be overbalanced transversely. Instead, it had to fall to the ground vertically by blasting (fig. 2 and 4).

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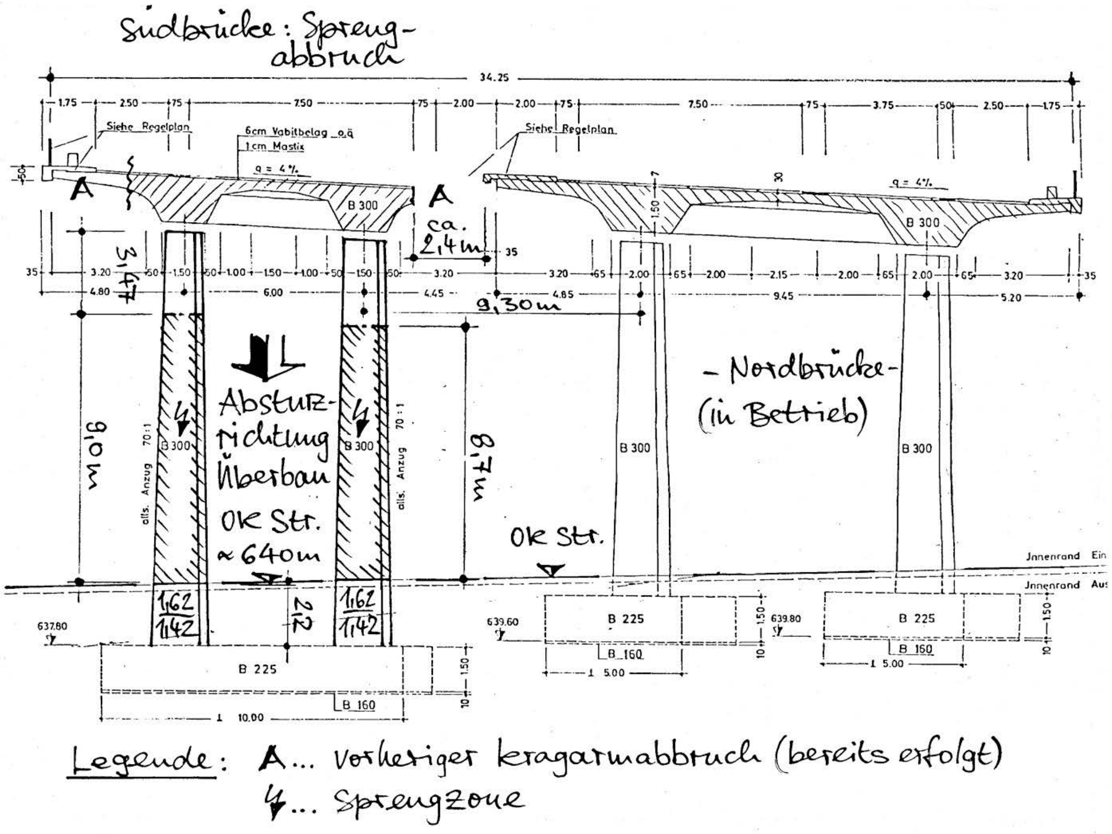

Fig. 4. Cross section of the bridge

Fig. 5. Southern bridge before the blasting

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In order to prevent the bridge plate from tilting sideways after hitting the ground, the pylons were blasted up to as much as 8 to 9 m. Only the last part of 3.5 m was not demolished.

The blasting was carried out by the blasting company Reisch. The blasting was planned by Melzer engineering consultants.

Fig. 6. Charging pylon 1

Fig. 7. Charging pylon 2

The lateral lengths of the pylon diameters measured approx. 1.1 to 1.7 m in the blasting zone. A vertical line of horizontal drill holes was drilled into the pylons (in a transverse direction across the bridge)
(fig. 6 and 7) and they were blasted electronically with a short-time delay.

Curtains were hung from the lane cantilevers in order to protect the neighbouring pylons from scattering material (fig. 5).

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The blasting zones themselves were not covered because there were no other objects to be protected and the shut-off zone was defined to be more than 300 m.

The impact of the bridge hitting the ground was reduced using a falling cushion of 1m high tephra. Three 3D measuring instruments were installed on the neighbouring bridge in order to monitor concussions.

Fig. 8a - 8c. Blasting the southern bridge

Following the necessary preparations, protection measures and charging, the southern bridge was blasted on 9th August 2012 (fig. 8a - 8c).

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Fig. 9. Southern bridge after the blast

Scattering material was found within a distance of approx. 200 m. The bridge fell right to the ground (fig. 9). The bridge plate broke right above the pylons. As expected, the remaining part of the bridge plate and the pylon heads were barely demolished.

Surrounding objects were not damaged. Due to the bridge not dropping down from a large height, no impact scatter was produced.

The vibrations measured on the neighbouring bridge were below the expected values and the standard reference value for no claims.

Applying the same procedure, the northern bridge was blasted on 8th April 2013 without causing any damages (fig. 10a - 10c, fig. 11).

Fig. 10a. Blasting the northern bridge

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Fig. 10b - 10c. Blasting the northern bridge

Fig. 11. Northern bridge, blast results

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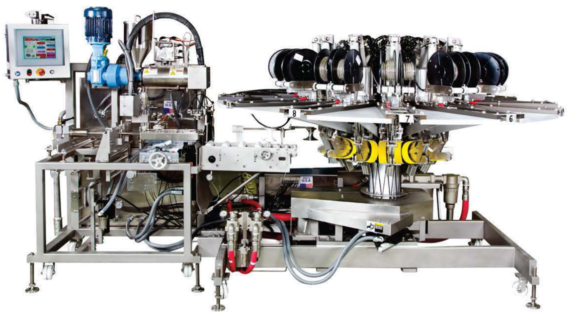

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ISEE Conference in Orlando 2017

After 15 hours travel from Sweden, via New York, Donald, Yvonne, Roger and Daga arrived Orlando on Saturday 28th.
Nearly 1,500 people from around the world met Jan. 29 - Feb. 1, 2017, in Orlando, Florida for the 43rd Annual Conference on Explosives and Blasting Technique. It features five days of workshops, technical sessions and entertainment.

Already on Sunday from 10.00 to 12.30 Donald was invited to a Regulatory panel discussion regarding legal country regulations. 6 representatives from US, Canada and Europe from different organizations were invited for the panel discussion in the well-attended assembly hall. Focus was on security and safety on transportation and handling of explosives.

The Panel

Donald represented Europe via EFEE and talked about our Committee works and especially the importance of the Track and Trace introduction, PECCS - the Pan European Competency Certificate for Shotfirers and Blast designers (funded by the Erasmus + programme from EC), new vibration standards and also he got a short chance to promote the next EFEE conference in Stockholm.

What we saw and heard was that Europe is doing very well.

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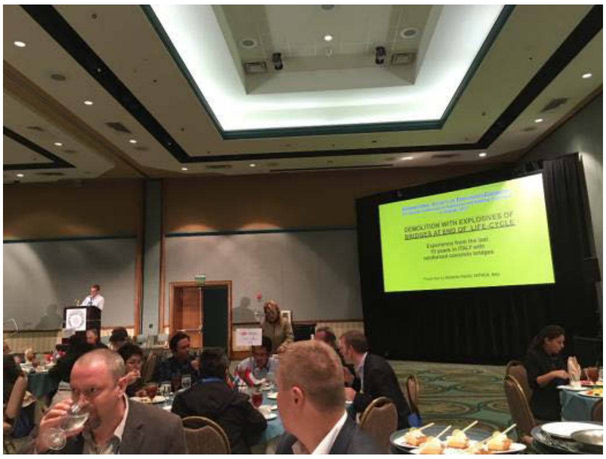
Donald waiting for his presentation



Roberto Folchi presenting bridge demolition

On the Monday International luncheon Roberto Folchi, Nitrex (Italy), held a very interesting presentation of bridge demolitions, "Demolition with explosives of bridges at the end of life-cycle".

Daniel Johansson presenting Fragblast in Luleå 2018

And Daniel Johansson from Luleå University and Svebrex (Sweden) got a good chance to promote the next Fragblast conference in Luleå 2018

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Daniel Johansson

The ISEE President Jack Eloranta handed out the award to Finn Ouchterlony

We will also give our congratulations to one of our famous well known Swedish researcher Professor Finn Ouchterlony, who had a paper regarding new theories in the deep fragmentation mathematics and for his long carrier he was honored with the Distinguished Service Award.

With more than 40 years in the explosives industry Ouchterlony has co-authored several project papers that included “Downhole Abrasive Jet Cutting Operations in Quarrying, Mining and Civil Engineering” and “Less Fines Production in the Aggregate and Industrial Minerals Industry.”

Ouchterlony is a member of the FRAGBLAST International Organizing Committee. He discovered the Swedish Blasting Research Centre distribution during the Less Fines Project, which led to his receiving the Douglas Hay award in 2005. Ouchterlony has been a member of ISEE since 1991.

Dale Preece, Ph.D., Orica Mining Services, was also honored with the Distinguished Service Award. Throughout his career, Preece has authored 135 technical papers and journal articles. He has also contributed to several books including the ISEE’s 18th edition Blasters’ Handbook. He has been invited to present a number of keynote addresses at conferences over the years.

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During the week Roger was well represented also in International Committee meetings and overall we had a very positive courteous reception from the ISEE representatives.

Roger, Finn and Donald

One of the good presentation came from Nobel Insurance who presented claims from blasting which seems to be vibrations with more than 60%. Transportation is No2.

Our mission to represent EFEE in this global ISEE conference and promote our value terms for our EFEE members we working so hard for, as knowledge, quality and safety and also a good profiling for our upcoming conferences, was well appreciated.

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With good friends at the Gala dinner

The next ISEE, Annual Conference on Explosives and Blasting Technique, will be in Jan. 28 - 31, 2018, at the Grand Hyatt Hotel in San Antonio, Texas.

We can also say that our next EFEE conference in Stockholm September 10-12 this year looks very attractive and many signed up to come.

Donald and Roger

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2017 Technical Committee members

Members and non-members of EFEE are always invited to present papers at the EFEE Conferences. We are pleased to introduce you to members of the 2017 Technical Committee who are responsible for choosing papers of high quality which will be presented at the next 9th World Conference on Explosives and Blasting which will take place in Stockholm from 10th - 12th September 2017.

Roger Holmberg, Sweden – (Chairman)

After graduation in 1972 he was working as Blasting Research Engineer for the Swedish Detonic Research Foundation (SveDeFo). He performed research in many quarries and mines about operating systems and wrote computer codes for bench, tunnel blasting and thermodynamic codes for explosives performance calculations. Roger was the President of SveDeFo in 1982-86.

Roger has been involved as a blasting consultant in many places in the world for construction and mining companies and for governmental bodies. He was one of the founders of the International Society of Rock Fragmentation by Blasting. He was four years in the Board of Directors of the Int. Society of Explosives Engineers (ISEE) and for two years he served as the President of the European Federation of Explosives Engineers (EFEE). Roger has had various positions at Nitro Nobel, Dyno Nobel, Orica and Nitro Sibir. Today he is working as Secretary General for EFEE. Roger is author and co-author of over 100 publications.

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Robert Farnfield, UK

After graduating from Leeds University with a degree in Mining, Rob carried out research into the environmental impact of coal outbit blasting for more than 10 years with funding from the UK's National Coal Board Opencast Executive.
Rob then moved on to become a lecturer in Mining Engineering at Leeds and completed Ph.D. in the environmental impact of surface mine blasting.

For the last 17 years he has worked for EPC-UK, initially as Technical Services Manager dealing with all aspects of the use of explosives. In 2007 he was appointed as Technical Services Manager for EPC Group Area B while holding a brief watch over technical matters in Northern and Eastern Europe. He is now Head of Explosives Engineering for EPC-UK. Rob is a Member of the UK's Institute of Explosives Engineers and The International Society of Explosives Engineers. Rob has published many papers relating to explosives engineering and is a well-known speaker throughout the industry.

Finn Ouchterlony

Finn Ouchterlony graduated from the Royal Institute of Technology in Stockholm, Sweden in 1980 (Tekn.Doktor) and received his honorary degree from Montan-universität Leoben (Dr.mont.h.c.) in 2007. His skills include fracture mechanics, blast damage and blast fragmentation. From 1967 to 1984 he was employed by Atlas Copco and worked mainly at the Swedish Detonic Research (SveDeFo) labs in Vinterviken. In 1987-1993 he was the head of SveDeFo labs, during 1993-2003 the head of the blasting research at SveBeFo and in 2003-2010 the head of the Swedish Blasting Research Centre, Swebrec. He has held academic positions at Luleå Univ. Technology (1985-88), Yamaguchi Univ., Ube, Japan (1991-92), Luleå Univ. Techn. (2003-2010) and Montanuniversität Leoben, Austria (2011-2014).

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Finn Ouchterlony was co-author of the EU funded projects “Downhole Abrasive Jet Cutting Operations in Quarrying, Mining and Civil Engineering” (BE-1671; 1996-99) and together with Prof Peter Moser of “Less Fines Production in Aggregate and Industrial Minerals Industry “ (GRD-2000-00438; 2001-2004). He has a long experience of working with industry related explosives and blasting projects. He was the co-ordinator of the ISRM working group WG on Fracture Toughness Testing of rock, which led to suggested methods in 1988. He is a member of the editorial boards of the journals: 1) Blasting and Fragmentation (ISEE), 2) Int. J. Rock Mechanics and Mining Sciences and 3) Rock Mechanics and Rock Engineering. He is a member of the int. organizing committee of the triennial Fragblast symposia. He discovered the Swebrec distribution during the Less Fines project. This led to the Douglas Hay award in 2005.

Jörg Rennert, Germany

Jörg Rennert (Dipl. –Ing. –Päd) is a German Citizen, born May 22, 1965, in Roßlau, Germany. His educational achievements include a high-school graduate in steelworking for metallurgical engineering and a diploma: Dipl.-Ing.-Päd. from the Technical University of Dresden. Jörg’s professional career includes being a steelworker for metallurgical engineering in the steelwork in 1985.

A scientific employee of the Technical University of Dresden in 1991. Assistant professor at Sprengschule Dresden GmbH from 1992 to 1998. Jörg progressed to managing director of The Dresdner Sprengschule GmbH and leader of business fields Blasting Technology and Pyrotechnics in 1998. In 2001 Jörg became president of the German Blasting Association (Deutscher Sprengverband e.V.). In 2010 he was elected as vice president of EFEE and was the president of EFEE between 2012 and 2014. Since 2008 Jörg is also the Chairman of the EU-Directives in EFEE.

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Jerry Wallace, US

Jerry R. Wallace came into blasting naturally – as a 5th-generation logger in the U.S. Pacific Northwest. A licensed professional blaster for over 35 years, Jerry founded Wallace Technical Blasting, Inc. in 1992. The firm specializes in close-in civil construction blasting, and now includes Jerry's two sons who are earning their own stripes in the industry.

Jerry studied Forest Engineering at Oregon State University, including coursework in explosives engineering. He has taught numerous professional blasting courses including within the University of Washington (Seattle) Professional Engineering Program. An active ISEE member since 1984, Jerry served on the ISEE Board for 12 years including a two-year stint as president. Jerry is one of the many co-authors of the 17th and 18th editions of the ISEE Blasters Handbook. Jerry has served on several governmental advisory committees dealing with explosives and industrial safety laws and regulations in the U.S. Jerry has been active in EFEE since the first conference in Munich in 2000, has attended each of the 8 previous EFEE conferences and presented papers at 3 of them.

Igor Kopal, President of EFEE

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New EFEE members

EFEE likes to welcome the following Members who recently have joined EFEE

Corporate Members

1R Demolition (Ykkösräjäytys OY), Finland
http://www.1r.fi

Individual Members

Francois Ledoux, YARA, Belgium

Malcolm Ingry, MJI Associates Ltd, UK

Tönu Tomberg, Tallinn University of Technology, Estonia

Student Members

Kristel Veersalu, Tallinn University of Technology, Estonia

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Upcoming Events

ISEE 43rd Annual Conference on Explosives and Blasting Technique January 29 – February 1, 2017
Orlando, USA
www.isee.org

IExpE AGM and Conference 2017 April 3-4, 2017
QHotels, Norton Park, Sutton Scotney, Winchester, SO21 3NB
Further information Vicki Hall by email: vicki.hall@iexpe.org

World Tunnel Congress 2017
June 9-16, 2017
Bergen, Norway
www.wtc2017.no

MPES 2017
26th INTERNATIONAL SYMPOSIUM ON MINE PLANNING & EQUIPMENT SELECTION
August 29-31, 2017
Luleå, Sweden
http://www.ltu.se/research/subjects/Mining-and-Rock-Engineering/Konferenser/MPES-2017?l=en

EFEE 9th World Conference on Explosives and Blasting
September 10-12, 2017
Stockholm, Sweden
www.efee.eu and
http://efee2017.com/

Fragblast 12
June 11-13, 2018
Luleå,Sweden
http://www.ltu.se/research/subjects/Mining-and-Rock-Engineering/Nyheter/FRAGBLAST-to-Lulea-2018-1.143098?l=en

HILLHEAD
June 26-28, 2018
Derbyshire, UK
www.hillhead.com

EFEE 10th World Conference on Explosives and Blasting
2019
Helsinki,Finland

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9th WORLD CONFERENCE
THE BREWERY, STOCKHOLM, SWEDEN

STOCKHOLM 2017

10th - 12th September

1st Circular - Call for Papers

President's Foreword

At the beginning of my foreword and on behalf of the European Federation of Explosives Engineers - EFEE I would like to invite you all to our next 9^{th} World Conference on Explosives and Blasting which will take place in Stockholm from 10^{th} - 12^{th} September 2017.

The EFEE World Conference on Explosives and Blasting has established itself as one of the most important international blasting events. It all started in year 2000 with 1^{st} EFEE World Conference in Munich and after Prague 2003 it continues on regular basis with a 2 years period. All eight of our previous EFEE World Conferences with great success proved how really important events where we can mutually share our different experiences and skills are.

We expect the EFEE 9^{th} World Conference on Explosives and Blasting to be as successful as our previous World Conferences and will attract participants and delegates not only from Europe but also from all over the World. The Conference is organised in cooperation with the Swedish national association - Swedish Rock Construction Committee (Bergsprängningskommittén).

Stockholm is the cultural, medial, political, and economical centre of Sweden. It hosts the annual Nobel Prize ceremonies and banquet at the Stockholm Concert Hall and the Stockholm City Hall. The earliest written mention of the name Stockholm dates from 1252, by which time the mines in Bergslagen made it an important site in the iron trade. Stockholm is located on Sweden's south-central east coast, where the freshwater Lake Mälaren — Sweden's third largest lake — flows out into the Baltic Sea. The central parts of the city consist of fourteen islands that are continuous with the Stockholm archipelago. Over 30% of the city area is made up of waterways and another 30% is made up of parks and green spaces. The city's oldest section is Gamla stan (Old Town), located on the original small islands of the city's earliest settlements and still featuring the medieval street layout. Stockholm is one of the cleanest capitals in the world. The city was granted the 2010 European Green Capital Award by the EU Commission; this was Europe's first "green capital".

The most important fact which has to be highlighted in relation to our Conference - is that on 21^{st} of October 1833 was born in Stockholm Alfred Bernhard Nobel the Swedish chemist, engineer and innovator worldwide known for inventing the dynamite. During the Conference the participants and spouses can choose various options which is offering attractive Stockholm for sightseeing and visit of different interesting places.

EFEE 9^{th} World Conference on Explosives and Blasting 2017 will take place at the Brewery - Conference Centre Stockholm a short walking distance from city centre. The venue offers unique conference room and halls, is bright, spacious and modern with excellent loading and logistic possibilities coupled with great interior structural design, which enables a natural flow for the participants. During breaks, participants can enjoy some fresh air out on the 40-meter long terrace or just savour the breath-taking panoramic view of the city centre of Stockholm and the sparkling waters surrounding it. Experiences like these really confirm the feeling of being in one of the best conference spaces in Stockholm.

The Conference will start on Sunday 10^{th} September with registration, workshop and welcome reception and will continue on Monday 11^{th} September and Tuesday 12^{th} September with technical sessions and exhibition. The Gala dinner is planned for Monday evening and will take place at Winterviken in former Alfred´s Nobel factory. Superb building that dates back to 1891 with wooden beams and classic features will host this event. In accordance with experiences from our previous eight Conferences we expect attendance over 450 delegates and professionals from over 50 different countries with a large industry exhibition. This will enable to create really unique forum for meetings and discussions of professionals from tunnelling, construction, demolition, quarry as well as mining industry. We have to share mutually everything new, good experiences - as well as bad experiences to avoid mistakes in the future and improve the techniques. It applies to all of us - explosives end-users, manufactures, drilling and blasting operators, consultants and contractors.

Finally please let me point out one more time the importance of EFEE 9^{th} World Conference on Explosives and Blasting and I´m really looking forward to meeting you all in Stockholm from 10^{th} - 12^{th} September 2017.

Igor Kopal
EFEE President

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EFEE

About the Conference

The EFEE World Conference has established itself as one of the key international explosives forums. Our Lyon conference in 2015 was attended by over 450 delegates from 55 countries with a large industry exhibition.

The conference includes technical presentations, an industry exhibition, educational workshops, welcome drinks reception, gala dinner and partner activities. The event draws attention from explosives users, manufacturers and equipment for drilling operations as well as researchers and professionals involved in the construction and mining industry.

Our Objectives

To bring together explosives and blasting professionals to share knowledge, network and develop the industry. The conference will provide us with an excellent forum to share the latest developments and technical practices combined with a fantastic opportunity to network with peers throughout the world.

Technical Programme

The technical sessions will be divided into key themes. Authors will present their papers in English to an audience in a lecture style format with some time for questions from the audience.

Each presentation will run for 20-25 minutes which will be overseen by the Program Committee. Those papers of high quality that cannot be presented due to the time constraints of the conference may be shown in a specific poster session adjacent to the exhibition area. The conference will focus on practical papers on the following themes:

- EU Directives and Harmonisation Work
- Health, Safety and the Environment
- Blast Vibration and Seismology
- Technical Development
- Shot Hole Development
- Blasting Work Experiences
- Construction Blasting
- Clearance and Decontamination
- Management Blast Design
- Explosive Detection for Security
- New Applications and Training

Call for papers

Members and non-members of EFEE are invited to submit abstracts for papers to be presented at the Conference. All accepted papers will be published in the conference proceedings which are available in both hard copy and USB formats.
Authors **must** be prepared to present their papers in person and in English. Each participant including authors and speakers are expected to pay the full registration fee.
Please note that papers **must not** be of a commercial or advertising nature.

Abstracts

Authors are invited to submit an abstract in English. The full paper **must** be submitted and **presented in English**. An abstract condenses a proposed paper by summarising and highlighting its major points into 200 - 400 words. The abstract should be a written summary of work done on the project, what conclusions have been drawn and recommendations made as a result of the project. The proposed paper should **not** be of a commercial or advertising nature.

Author's paper formatting and presentation guidelines as well as our online submission form are available on the conference website: www.efee2017.com.

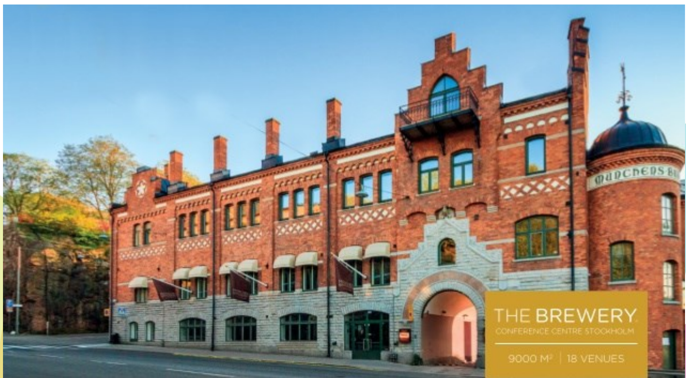
Submit your abstract online, visit www.efee2017.com

Official Languages

The official language of the conference is **English**.
[A translation service will not be provided.]

Publication Policy

All accepted papers received by the deadline and presented at the conference will be published in the conference proceedings in both USB memory stick and printed formats. Proceedings will be distributed to all registered delegates at the conference.



Exhibition

A large industry exhibition will be held in parallel to the technical presentations. The exhibition provides an ideal opportunity for users of explosives, consultants, suppliers and manufacturers to demonstrate their latest developments to a wide cross section of the industry.

If you are interested in exhibiting at the conference please indicate your interest by emailing exhibition@efee2017.com or by visiting http://www.efee2017.com

Sponsorship

There are a variety of sponsorship and advertising opportunities available which will raise your company profile at this international event. For further information on sponsorship please email exhibition@efee2017.com

Offsite Workshop and Site Visit

For the first time in EFEE Conference history the workshop will include a site visit to the biggest road construction project in Sweden - E4 The Stockholm bypass – Förbifart Stockholm.

E4 The Stockholm bypass – Förbifart Stockholm is a new route for the European highway (E4) past the Swedish capital connecting the southern and northern parts of Stockholm.

This essential new section of Stockholm network is 21 km long with over 18 km being routed underground, to reduce the impact on Stockholm's natural and cultural environment, requiring a huge amount of drilling and blasting work using the very latest research and technology.

After this superb visit we will have the unique opportunity to discuss the project with the client, contractors and consultants including key areas of the design, environmental impacts, challenges in blasting and much more.

The workshop will be conducted in English only. Further information on the workshops will be available on our website: http://www.efee2017.com

Partner Activities

A varied and interesting selection of activities will be available, giving visitors the opportunity to see Stockholm's spectacular Drottningholm Palace, old town, beautiful lakes, scenery and culinary delights.

Venue Information

The 2017 EFEE conference will take place at The Brewery a short distance away from Stockholm's beautiful city centre and overlooking the Mälaren water. The Brewery is in close proximity to public transport making it a easy to explore this stunning capital. High speed internet access is available throughout the venue. We are working in association with the Hilton Stockholm for accommodation which is a short walk from the venue.

http://m-b.se/en/

Location

To view the location please visit the Google map link:
https://goo.gl/maps/zS6Pmgm4TAP2

Registration Fee

The early bird registration fee for participants will be:

Delegate (Non EFEE Member):	6,800 SEK (excluding tax)
Student:	500 SEK (excluding tax)
EFEE Members:	6,100 SEK (excluding tax)

Including: Individual, Company and Associate Members - one discounted registration only.

EFEE Corporate/National Members: 5,400 SEK (excluding tax)

Corporate/National Members are entitled to one discounted registration only.

All participants including authors are expected to pay the registration fee.

Participation

If you are interested in attending the conference please register at **http://www.efee2017.com**

Accommodation

There are many accommodation options in Stockholm to suit all preferences and budgets. Accommodation has been held at the adjacent Hilton Stockholm will be available to book through the conference website. To view all of the local accommodation options please click on the hyperlink below:
http://www.booking.com/city/se/stockholm.en-gb.html

Conference Committee

Heinz Berger (Chairman)
José Carlos Gois
Roger Holmberg
Donald Jonson
Jari Honkanen
Johan Finsteen Gjødvad
James Tyler

Deadlines

Abstracts & Papers

10 February 2017	**Deadline for submission of abstracts**
10 March 2017	**Notification of acceptance of abstracts**
31 March 2017	**Distribution of 2nd Circular with Preliminary Programme**
10 May 2017	**Submission of final papers**
10 June 2017	**Final notification of acceptance of paper**

Registration

January – July 2017	**Early Bird Registration**
August – September 2017	**Standard Registration**

Technical Committee

Roger Holmberg (Chairman), Sweden

After graduation 1972 he was working as Blasting Research Engineer for the Swedish Detonic Research Foundation (SveDeFo), performed research in many quarry and mining operations and wrote computer codes for bench, tunnel blasting and thermodynamic codes for explosives performance calculations. Roger was President for SveDeFo 1982-86. Roger has been involved as a blasting consultant in many parts of the world, for construction and mining companies and for governmental bodies. He was one of the founders of the International Society of Rock Fragmentation by Blasting. He paid four years' service as a Board of Directors of the Int. Society of Explosives Engineers (ISEE) and two years as President for the European Federation of Explosives Engineers (EFEE). Roger has had various positions at Nitro Nobel, Dyno Nobel, Orica and Nitro Sibir. Today he is working as Secretary General for EFEE. Roger is author and co-author of over 100 publications.

Robert Farnfield, UK

After graduating from Leeds University with a degree in Mining, Rob carried out research into the environmental impact of surface coal mine blasting for more than 10 years with funding from the UK's National Coal Board Opencast Executive. Rob then moved on to become a lecturer in Mining Engineering at Leeds and completed a Ph.D. in the environmental impact of surface mine blasting. For the last 17 years he has worked for EPC-UK, initially as Technical Services Manager dealing with all aspects of the use of explosives. In 2007 he was appointed Technical Services Manager for EPC Group Area B with a watching brief over technical matters in Northern and Eastern Europe. He is now Head of Explosives Engineering for EPC-UK. Rob is a Member of the UK's Institute of Explosives Engineers and The International Society of Explosives Engineers. Rob has published many papers relating to explosives engineering and is a well-known speaker throughout the industry.

Finn Ouchterlony, Sweden

Finn Ouchterlony graduated from the Royal Institute of Technology in Stockholm, Sweden in 1980 (Tekn.Doktor) and received his honorary degree from Montan-universität Leoben (Dr.mont.h.c.) in 2007. His skills include fracture mechanics, blast damage and blast fragmentation

From 1967 to 1984 he was employed by Atlas Copco and worked mainly at the Swedish Detonic Research (SveDeFo) labs in Vinterviken. During 1987-1993 he was head of the SveDeFo labs, during 1993-2003 head of the blasting research at SveBeFo and 2003-2010 head of the Swedish Blasting Research Centre, Swebrec. He has held academic positions at Luleå Univ. Technology (1985-88), Yamaguchi Univ., Ube, Japan (1991-92), Luleå Univ. Techn. (2003-2010) and Montanuniversität Leoben, Austria (2011-2014).

Finn Ouchterlony was co-author of the EU funded projects "Downhole Abrasive Jet Cutting Operations in Quarrying, Mining and Civil Engineering" (BE-1671; 1996-99) and together with Prof Peter Moser of "Less Fines Production in Aggregate and Industrial Minerals Industry " (GRD-2000-00438; 2001-2004). He has a long experience of working with industry related explosives and blasting projects.

He was the co-ordinator of the ISRM working group WG on Fracture Toughness Testing of rock, which led to suggested methods in 1988. He is a member of the editorial boards of the journals: i) Blasting and Fragmentation (ISEE), ii) Int. J. Rock Mechanics and Mining Sciences and iii) Rock Mechanics and Rock Engineering. He is a member of the int. organizing committee of the triennial Fragblast symposia. He discovered the Swebrec distribution during the Less Fines project. This led to the Douglas Hay award in 2005.

Jörg Rennert, Germany

Jörg Rennert (Dipl. –Ing. –Päd) is a German Citizen, born May 22, 1965, in Roßlau, Germany. His educational achievements include a high-school graduate in steelworking for metallurgical engineering and a diploma: Dipl.-Ing.-Päd. from the Technical University of Dresden. Jörg's professional career includes being a steelworker for metallurgical engineering in the steelwork in 1985. A scientific employee of the Technical University of Dresden in 1991. Assistant professor at Sprengschule Dresden GmbH from 1992 to 1998. Jörg progressed to managing director of The Dresdner Sprengschule GmbH and leader of business fields Blasting Technology and Pyrotechnics in 1998. In 2001 Jörg became president of the German Blasting Association (Deutscher Sprengverband e.V.). In 2010 he was elected as vice president of EFEE and was the president of EFEE between 2012 and 2014. Since 2008 Jörg is also the Chairman of the EU-Directives in EFEE.

Jerry Wallace, US

Jerry R. Wallace came into blasting naturally – as a 5th-generation logger in the U.S. Pacific Northwest. A licensed professional blaster for over 35 years, Jerry founded Wallace Technical Blasting, Inc. in 1992. The firm specializes in close-in civil construction blasting, and now includes Jerry's two sons who are earning their own stripes in the industry. Jerry studied Forest Engineering at Oregon State University, including coursework in explosives engineering. He has taught numerous professional blasting courses including within the University of Washington (Seattle) Professional Engineering Program. An active ISEE member since 1984, Jerry served on the ISEE Board for 12 years including a two-year stint as president. Jerry is one of the many co-authors of the 17th and 18th editions of the ISEE Blasters Handbook. Jerry has served on several governmental advisory committees dealing with explosives and industrial safety laws and regulations in the U.S. Jerry has been active in EFEE since the first conference in Munich in 2000, has attended each of the 7 previous EFEE conferences and presented papers at 3 of them.

Previous Conferences

1st World Conference
Munich, Germany 2000

2nd World Conference
Prague, Czech Republic 2003

3rd World Conference
Brighton, UK 2005

4th World Conference
Vienna, Austria 2007

5th World Conference
Budapest, Hungary 2009

6th World Conference
Lisbon, Portugal 2011

7th World Conference
Moscow, Russia 2013

8th World Conference
Lyon, France 2015

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