EFEE

NEWSLETTER

December edition

Mining Authorities meeting in Poland

Weapons, Ammunition and Explosives Transport Management System - SIGESTAME

Testing the constructive strength of a container arranged as a mobile deposit of explosive materials II

...and more!

EFEE

12th WORLD CONFERENCE ON EXPLOSIVES AND BLASTING

DUBLIN, IRELAND

9th - 12th September 2023 | Royal Dublin Society

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European Federation of Explosives Engineers efee.eu

December edition

We in EFEE hope you will enjoy the present EFEE-Newsletter. The next edition will be published in February 2023. Please feel free to contact the EFEE secretariat or write to newsletter@efee.eu 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 an upcoming Newsletter edition

or any other matter.

Mathias Jern, Chairman of the Newsletter Committee and the Vice President of EFEE and Teele Tuuna, Editor of EFEE Newsletter - newsletter@efee.eu

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Dear friends,

the President's voice

It is my honour to welcome you to our fourth and final issue of the *2022 EFEE* newsletter.

As the month of December comes to a close, I would like to sincerely thank you all for your continued support and loyalty. It has been a great honour for me to work this my first term as president of EFEE. As you are all aware this spring we witnessed the saddening news of war in Ukraine, and with this news the unpredictable and complicated effect it has had on our industry. Not knowing the availability of explosives, fluctuating prices, plus significant challenges in planning and delivery of service has led to serious economic losses. During this time customer service has also been affected in a negative way.

Many employees and blasters had to remain 'on call' at home, while in other areas increased workload meant some teams struggled to cope.

No one could predict such challenges and disruptions. Yet we got through this hectic period – kudos to all!

We learnt to adapt, be more flexible, inventive and creative, and come up with new solutions and different approaches. I believe it will make for fascinating reading.

So we invite all our members to come and help us in our constant work to develop and improve our association.
How to do this?
You can join our existing research team working with vibration standards and CO_2calculations, or add your name to our innovative team who creates platforms for sharing information about accidents or near misses among explosives users in order to learn.

Maybe you could help us design a new pillar in our future strategy "Demolition with explosives" for PECCS 2023 Erasmus + project. Of course, you are welcome to bring completely new thoughts and ideas!

EFEE is created for the benefit of our industry, which means all of us, so take your time and consider joining us.

For the upcoming year, I will participate in ISEE 49th Annual Conference on Explosives and Blasting Technique. In 2023 it will take place from the 3rd to 8th of February in San Antonio, Texas, USA.

I am so looking forward to seeing good friends and colleagues there, and I would really appreciate to hear how 2022 was for you in business?
i.e. has there been a lot of changes and how have you handled the situation in our industry?

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Let's share experiences, ideas and prepare for the new season together. I am positively anticipating (with fingers crossed) more stability in our industry next year after thse recent years of turmoil.

Plus please save the date 9th- 12th of September 2023 for the 12th World Conference of EFEE, which will take place in Dublin, Ireland.

Since our very successful Maastricht conference we've been working hard throughout the summer and autumn preparing for Dublin. I can assure you we are planning to bring something very exciting, so stay tuned for updates.

Those of you who have been visiting ISEE conferences probably know all about the *Emerging Professionals* reception.

We were extremely happy to see such a high number of students visiting EFEE Conference this year, we would like to see more people like this in future. Therefore, it was decided to organise our own *Emerging Professionals* reception at our 12th World Conference in Dublin.

It is very important to understand what we mean by *emerging professionals*, it has nothing to do with age or education, it is meant for people who have been in the industry less than 10 years. We wish to connect with them and exchange contacts while mingling in a relaxed atmosphere.

Now to finish 2022, it is time to say goodbye to this difficult year and we all sincerely hope that next year brings us a safer world to live and work in.

In the meantime we will hold our heads high and focus on the positive!
The next EFEE Newsletter is planned for February 2023.

On behalf of EFEE I wish you all a very peaceful holiday and a lot of happiness for the new year!

Viive Tuuna
President of EFEE

Unrivaled shock tube quality at 400 m/min with the lowest scrap rate on the market

That is now possible with premium equipment from Rosendahl Nextrom, a newcomer in the explosives industry, but with decades of experience in high-precision extrusion technology.

Let us introduce you to Rosendahl Nextrom. The European company with headquarters and production facilities in Austria is a leading global supplier of manufacturing solutions for cables and wires. In fact, in the cable industry, there is no getting around the name Rosendahl Nextrom. For more than six decades the company has been specializing in extrusion technology and developing production lines and machinery for cable manufacturers worldwide, including high-precision solutions for medical technology, aerospace, and the military.

A premium shock tube line setting new standards

Just recently, Rosendahl Nextrom entered the market for explosives with their premium production line for shock tubes. This production line incorporates the extensive process and material knowledge that our experts have gathered over the past decades. Extrusion is what they do best, so it's no wonder their shock tube production line sets new standards in this industry, too.

The so-called RC-I line is designed to produce three-layer shock tubes. That leads to enhanced quality and resistance compared to conventional two-layered products. Even powder distribution, a perfect diameter, and high physical and mechanical resistance characterize shock tubes produced on Rosendahl machinery. The production lines run at a speed of up to 400 m/min. During continuous production, the average scrap rate remains below 1 %. This setup will take the production capacity of shock tube manufacturers to a new level.

Everything perfectly coordinated by a single source

High quality, high speed, and an economical use of materials – all of this together makes Rosendahl equipment highly interesting for current and future shock tube producers. Each production line can be adapted to individual requirements. On top, Rosendahl customers profit from in-depth training on site, powerful smart solutions, as well as excellent service and support worldwide. Everything from one source. 100% made in Europe.

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Mining Authorities meeting in Poland

Robert Laszlo, National Institute for Research and Development in Mine Safety and Protection to Explosion INSEMEX Petrosani, 32-34 G-ral. Vasile Milea Street, Petroșani, 332047, Romania

After a 3-year break, the traditional meeting of the Heads of European State Mining Authorities was resumed. The 26th meeting was hosted by representatives of Poland and took place in Krotoszyce, between 25-28 September 2022, the theme of this year's debates being *"Aspects regarding legal liability for losses caused by closed/abandoned mining facilities".*

The organization of the 2022 meeting in Poland was not a coincidence, this being the occasion of the anniversary this year of 100 years of uninterrupted activity for the Katowice State Mining Authority.

At this event, Romania was represented by INSEMEX, the delegation comprising 3 participants: Dr. Eng. George Artur Găman – General Director, Dr. Eng. Daniel Pupăzan – Technical Director, respectively Drd. Eng. Robert Laszlo – Head of Department Security of Explosives and Pyrotechnic.

During two days of meetings, the participants made different presentations on the topic of the meeting and made informative and technical visits. Thus, different themes were debated and the following presentations were made:

- R. Laszlo _ *Legal aspects of liability for currently occurring mining damages caused by the activities of former or abandoned mining plants* (Romania)

- K. Freytag _ *Structural change in the region of Lusatia* (Germany)

- M. Waksmanska _ *Liability for mining damage caused by former or abandoned mining operations* (Poland)

- O. Leinonen _ *Legal aspects of liability for currently occurring mining damages* (Finland)

- P. Bradley _ *Legal aspects of liability for currently occurring mining damages_* (UK)

- S. Balkovec _ *Examples of abandoned mining facilities in Slovenia*

- Ukrainian Ministry of Industry _ *Legal aspects of liability for current mining damage arising from former or abandoned mining operations* (Ukraine)

As well as, the meeting was attended by EU representant Mr. Daniel Cios , EU Policy Officer for Energy Intensive Industries – Raw Materials Department from Directorate General for Internal Market, Industry, Entrepreneurship and SMEs, who emphasized the importance of the mining industry in the current political and economic context and the EU plans regarding the strategic development of these industry.

On this occasion, the participants also paid a visit to the mining company KGHM Polska Midz S.A., one of the largest employers in the south-west of Poland and which globally ranks second in terms of silver production, respectively sixth place regarding copper production, with an annual consumption of over 7,000 tons. of explosives.

Visiting the KGHM mine

At the end of the meeting, the representatives of the participating states signed the Memorandum containing the main conclusions that resulted from the debates. It was also mutually agreed that the meeting in 2023 will be organized by the mining authority from the Czech Republic, the theme of the future working meeting being "Organization, structure and competences of State Mining Authorities in European countries".

Signing the declaration by Romania


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Arms, Ammunition and Explosives Transport Management System - SIGESTAME

Paulo Sérgio Magalhães da Costa
Head of Investigation and Enforcement Division
Arms and Explosives Department of the Portuguese Public Security Police (PSP)
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The management and use of explosive products and their precursors has been the object of attention and concern of other authorities, due to the destructive potential that explosives have. Thus, aware of the implications that illicit, incorrect, or negligent use may cause, there has been a constant regulation to ensure an effective and efficient monitoring of the transport and use of explosive products. This article summarizes the evolutionary path of the mechanisms adopted for the management of the transportation of arms, ammunition, and explosives. Therefore, we will focus, in greater detail, on the electronic and georeferenced system currently in use by the Public Security Police Department (PSP) - the System for the Management of the Transport of Arms, Ammunition and Explosives

1. Introduction

Since the discovery of black powder in the 9th century and the consequent and immediate awareness of its military capabilities, its possession, use and management has always been a concern. Today, and with the existence of implied and latent threats such as terrorism, this concern is felt even more intensely in the mind of various authorities with direct or indirect responsibility in ensuring the safe existence of explosive products within a community, considering the other existing affections that make the development and growth of society.

Also in Portugal, there has been a materialization of this concern through the development and an updating of regulations and the application of measures that allow the mitigation of risk and threat.

Sigestame

2. Evolutionary course

We will have to travel back to December 24th of 1902 to find the first regulation on explosives - materialized with the publication of Decree No. 2241, of February 29th of 1916. In this important moment we find the creation of a very complete and comprehensive diploma, which regulates all the activities, associated with explosive products and dangerous goods.

Later, in 1946, Decree-Law no. 36085, of December 31th, exclusively attributes to the General Command of the Public Security Police (PSP) the services of registration and inspection of arms, ammunition, and explosives, including their production, importation, trade, possession, and use, as well as the competence to inspect factories, re-sale establishments and warehouses of any nature, of explosives, arms, and ammunition.

Decree-law no. 36085, 25 years after its publication, was revoked by Decree-law no. 521/71 of November 24th, which was partially revoked by Decree-law no. 376/84 of November 30th.

The mentioned Decree-Law No. 521/71, whose legal provisions are still in use today, regulated the procedures for registration and supervision of production, import, export, trade, possession, storage and use of explosive substances and the prevention of security in places used for these activities, except for cases assigned to the Armed Forces. In terms of transport of explosives, Article 29 of this Decree-Law provides that the transport by land of quantities exceeding 500 kg is always accompanied by a graduate or guard of the Public Security Police or a police officer of the 'Guarda Nacional Republicana' or 'Guarda Fiscal'. [*Republican National Guard or Fiscal Guard*]

In 1984, with the publication of Decree Law No. 376/84, of November 30th, and the respective regulations the term of explosive substances used until this date disappeared and the term of explosive products and hazardous materials appear, making a physical and legal separation between them. This regulation assigned competence to the Explosives Inspectorate for the licensing and supervision of its legal provisions, as well as to the PSP, at the level of its police functions, in addition to those it already had according to other legal provisions.

In 1992, with the extinction of the Explosives Inspectorate, under Decree-Law No. 107/92 of 2 June 1992, its powers and duties were conferred to the PSP, thus consolidating in its area, at national level, all legal powers in the field of explosives and hazardous materials, as provided in the current Organic Law of the PSP, approved by Law No. 53/2007 of August 31st.

So, it is the responsibility of the PSP to license, control and monitor the manufacture, storage, marketing, use and transport of arms, ammunition, explosives and similar substances which do not belong or are not intended for the Military Forces and other Police Forces and Services. This mission is easily considered highly complex and dangerous due to the great diversity of existing operators and high quantities of explosives involved, as shown in the graphed figures below.

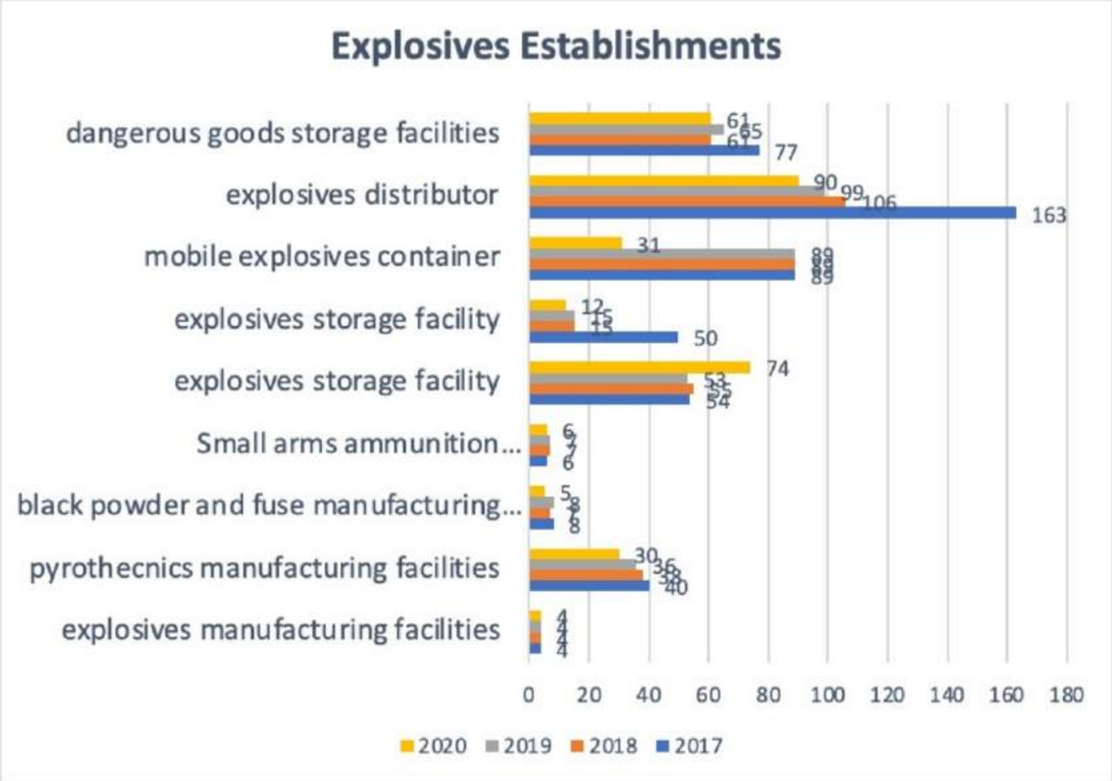


Figure 1. Number of explosives and hazardous materials facilities

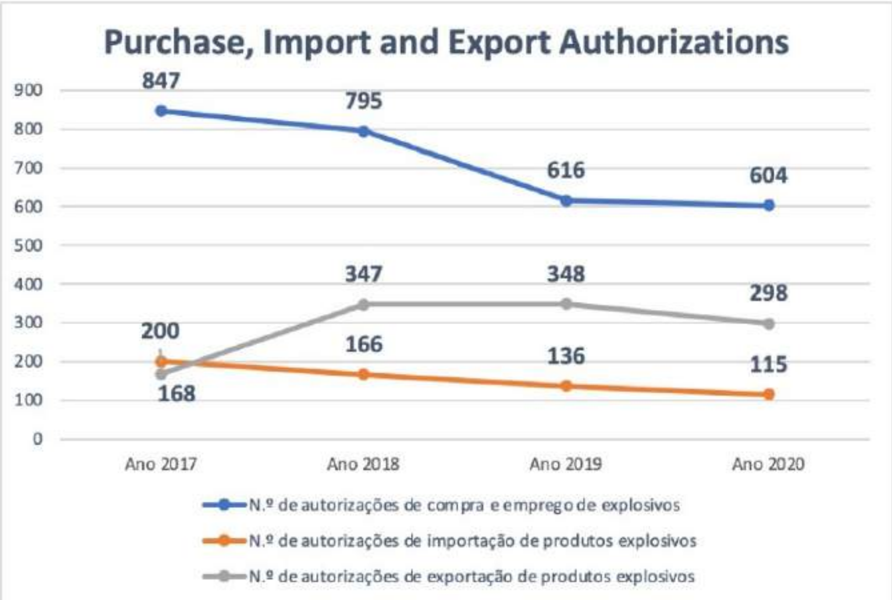
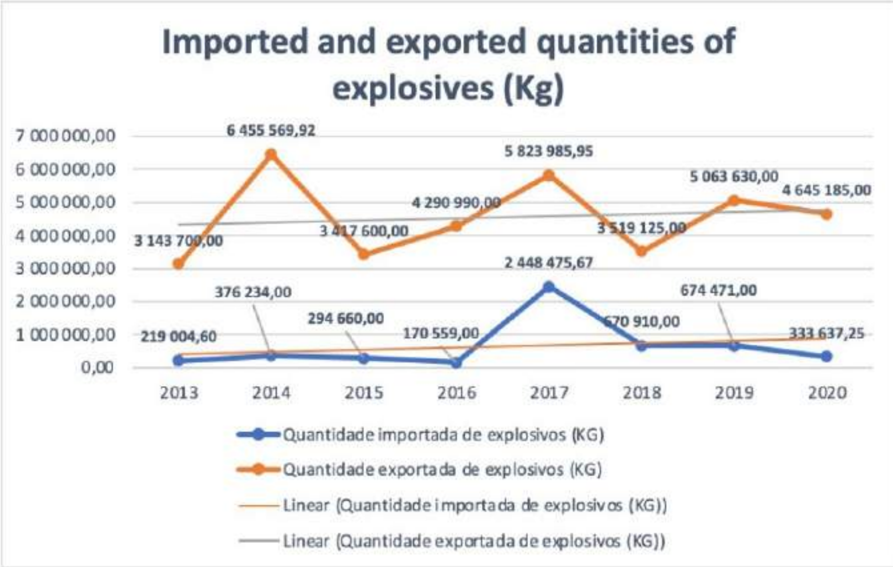


Figure 2 - Number of purchase, import and export permits issued by PSP.

Figure 4. Amount of explosives imported and exported authorized by PSP. ->



In 2020, Portugal exported around 5,000 tonnes of explosives, with the trend increasing..

Due to this concern and considering the high dispersion and antiquity of legislation (some legal regulations reach more than 30 years of validity) on explosives, as well as the obvious outdatedness of existing regulations given the reality of the sector and other related legal instruments, there was a need to rethink and update the existing mechanisms.

With the publication of Order No. 23935/2007, of October 3rd, a working group was created which included representatives of private sector entities and public organizations, in order to diagnose, analyze, study and propose solutions related to the need to ensure a safe and competitive industry in the explosives sector and related activities or products - thus proposing measures to support the sustained development of the activity and, at the same time, strengthening the security requirements.

Therefore, private sector entities (Associação Portuguesa dos Industriais de Pirotecnia e Explosivos - **APIPE**, Associação Nacional da Industria Extrativa e Transformadora - **ANIET**, Associação Nacional de Empresas de Produtos Explosivos - **ANEPE** and Associação Portuguesa de Estudos e Engenharia de Explosivos - **AP3E**) and public entities (**PSP**, Guarda Nacional Republicana - **GNR** and Direção Geral das Atividades Económicas - **DGAE**) teamed up and conducted a survey of issues and bureaucratic obstacles facing the activity - with a view to the subsequent presentation of measures to modernize and simplify the licensing processes and operation of the sector, as well as to analyze, interpret and harmonize the existing legal framework.

The working group identified as a priority action the analysis of an innovative system of security and management of the transport of explosives, enabling security conditions, the tracking of vehicles involved in transports of explosives, remote control and monitoring and including active and passive security mechanisms.

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Figure 4 - Objectives defined for the working group created with the Order no. 23935/2007, of October 3rd.

Consequently, came the Order No. 12687/2008 of April 23rd, which promoted the implementation of a pilot project to be developed in the transport of explosive products in companies' vehicles that integrate the project, up to the number of 6 vehicles, provided they are properly equipped, according to the appropriate security parameters. The implementation of this proposal allowed the application of security measures such as the tracking of vehicles transporting explosives with remote control and other active and passive security mechanisms.

In 2008, the report presented by the PSP about the development and application of the pilot project concluded that the application tested in the control of transport of explosives is effective and proposed an additional period for the development of new components that were not included in the initial project.

As a result of the growing innovative scope of the project, Order No. 30106/2008, of November 12th ,extended the schedule of the pilot project and required the working group to make a consistent analysis of the suitability, effectiveness, efficiency and general applicability of the system in the final report.

As a result of the success reported in the evaluation of the pilot project, Decree-Law 119/2010 of October 27th amended Decree-Law 521/71, which regulated the presence of police escorts in the transport of explosive products over 500 kg.

After this moment, the physical police escort was dispensed, when the carrier used an electronic georeferencing system to ensure the permanent monitoring of the transport and the immediate activation of alarms.

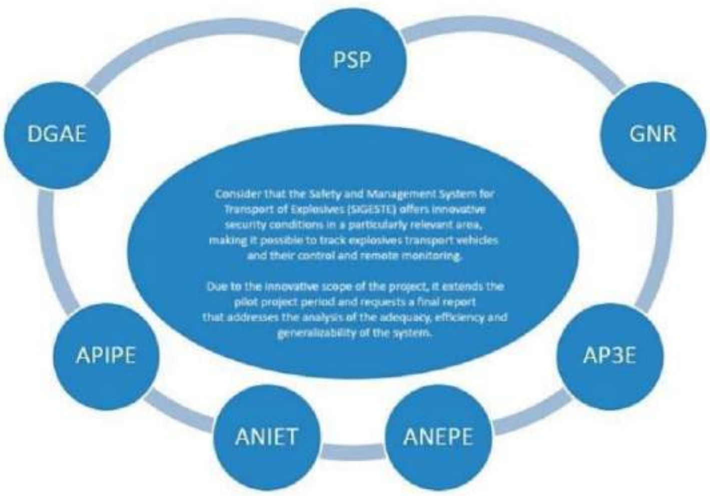


Figure 5 - Conclusions presented in the report conducted by PSP on the development and application of the pilot project created with the Order No. 23935/2007, October 3rd.

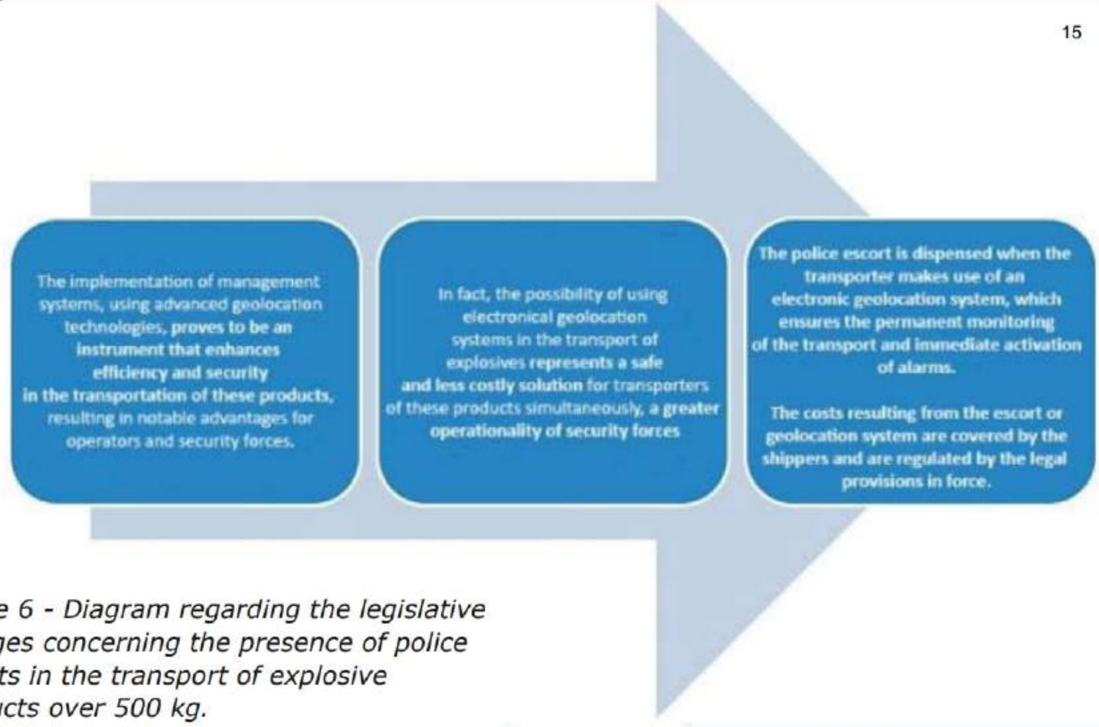


Figure 6 - Diagram regarding the legislative changes concerning the presence of police escorts in the transport of explosive products over 500 kg.

Subsequently, in 2016, Decree Law No. 48/2016 of August 22nd regulated the creation, implementation, management, and support of the electronic georeferencing system for the safe transportation of arms, ammunition, and explosive products - SIGESTAME.

It was also defined that the Public Security Police has exclusive access to the georeferencing system to monitor the security and control of the transport of arms, ammunition, and explosives - under the assumption that the PSP is the legal authority responsible for licensing, control and inspection of firearms, ammunition, and explosives, as provided in the current Organic Law of the PSP, approved by Law No. 53/2007 of August 31st

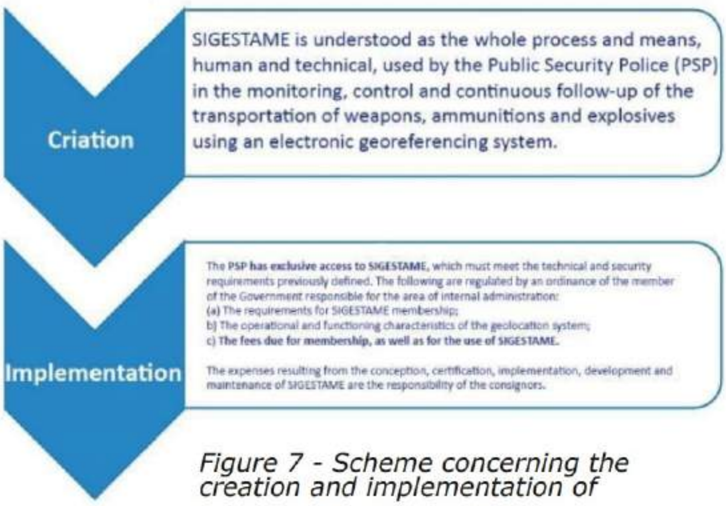
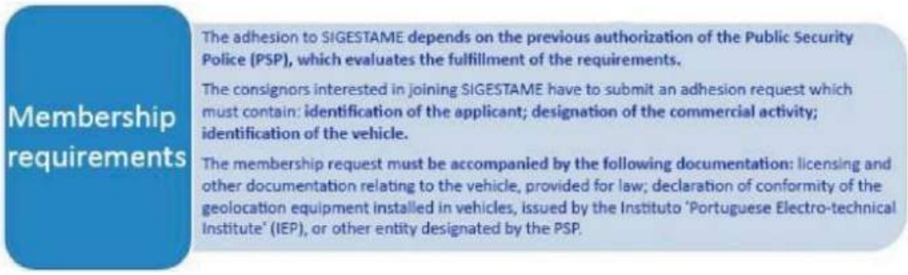


Figure 7 - Scheme concerning the creation and implementation of SIGESTAME after regulation introduced by the Decree-Law No. 48/2016, of August 22nd.

Figure 8 - Scheme referring to the requirements for adherence to SIGESTAME as provided in Decree Law No.48/2016, of August 22nd. ->



3. THE SIGESTAME

- Decree Law No. 48/2016, of August 22nd, defined the PSP as the competent authority to ensure the control of SIGESTAME, as well as:
  - Authorising access to the system
  - Update the register of adherents and approved vehicles of all companies.
  - Monitor all transports in every moment.
  - Adopt measures to control and supervise transport and the technical means used.
  - Designate the entities responsible for the certification system, as well as the equipment to be installed in the vehicles.
  - Establish and apply the appropriate measures to ensure the safety of the transports; and
  - Suspend, temporarily or permanently, the use of SIGESTAME.

To operate in SIGESTAME the companies are obliged to:

- Provide the PSP with all relevant information for the monitoring and control of transport.
- Fulfill and enforce the dates, times, and routes of the transport to be monitored.
- Immediately notify the PSP of any anomaly or incident during transport, as well as the immobilization of the vehicle, even if for justified reasons.
- Communicate any change in the respective licensing or vehicles used in transport.
- Ensure that the drivers of the transport vehicles are aware of the rules and procedures in the scope of transport under the SIGESTAME.
- Comply with and enforce all instructions and orders communicated to them by PSP during transport.

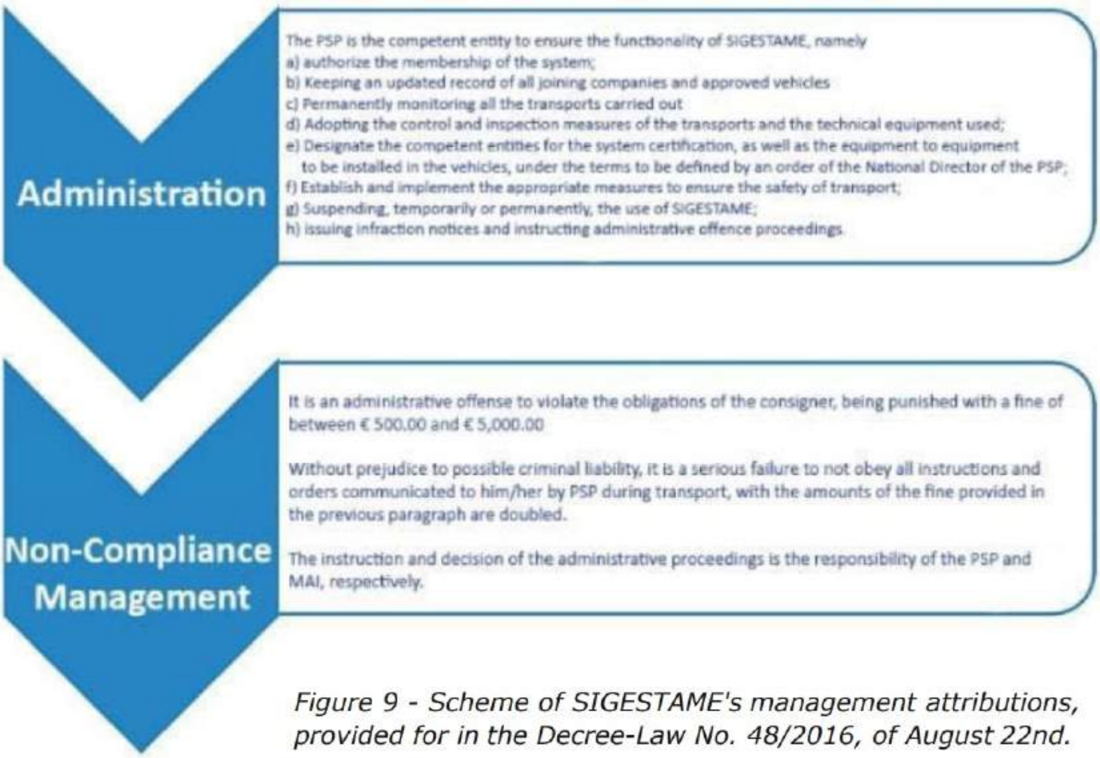


Figure 9 - Scheme of SIGESTAME's management attributions, provided for in the Decree-Law No. 48/2016, of August 22nd.

Figure 10 - PSP's Center for Strategic Command and Control. Service based at the National Directorate of PSP where police officers of the Arms and Explosives Department permanently operate SIGESTAME.

FEES

The following fees are due for the registration and use of SIGESTAME:

a) Vehicle certification - € 1.027;

b) Renewal of vehicle certification - € 258;

c) Request for monitoring - € 43.

Figure 11 - Fees related to SIGESTAME defined in Ordinance no. 345/2016, of 30 December - which regulated the fees due for membership, as well as for the use of SIGESTAME

Companies interested in joining SIGESTAME must submit an application

a) Identification of the applicant.
b) Designation of the commercial activity.
c) Identification of the vehicle, or vehicles, to be used.

However, the adhesion to the system will only be authorized and certified if the equipment installed in the vehicle guarantees total interoperability with SIGESTAME. The certificate, delivered by the PSP, will be valid for 3 years and the effective use of SIGESTAME depends on the prior payment of the legally established fees.

Operationally, the monitoring of the vehicle transporting explosive products begins after the sender's request to the PSP, by sending the request until 2:00 pm of the previous business day. After analyzing the request, the PSP adopts and communicates to the driver of the vehicle the necessary actions to ensure its safety.

Finally, and to enable an effective response to any incident/event reported by the operator/driver or reported by the PSP during SIGESTAME monitoring, a strict policing protocol was defined and adapted to each specific situation.

In other words, for a defined set of events planned in the SIGESTAME, there are risk levels assigned and suitably protocoled police actions that may involve from simple verification by the PSP, to a concerted action with the GNR and the civil protection system, if necessary.

Figure 12 - PSP's Strategic Command and Control Center. Service based at the National Directorate of PSP where police officers of the Arms and Explosives Department permanently operate SIGESTAME. ->

Operational and functional characteristics of the geolocation system

The equipment to be installed in the vehicle has to guarantee the correct interoperability with SIGESTAME and provide the following data

* Identify the vehicle by license registration number;

* Identify the situation in which the vehicle is in relation to the journey, including its exact location along the route and the road identification;

* Match, by message, who monitors and who is the driver;

* Real-time perception of the occurrence of any events relating to the various functionality of the vehicle, including its immobilization and the opening of doors;

* Compare between the route previously set and the route taken;

* Perform remotely, from the monitoring site, security actions associated with the vehicle's gear and other functions, such as immobilizing the vehicle, locking cargo doors and trigger alarms,

* Provide immediate information on the different actions taken by the driver, being, as a minimum, required the start of the route, stop or rest, end of route and call for help;

* Check all events that occurred in the last 24 hours, as well as the alert levels detected in the same period of time;
* Issuing daily reports or reports on particular events;
* The collection of image and sound when in an emergency situation;

* Allowing the definition of alert levels.

Figure 13 - Operational and functioning characteristics of the geolocation system defined in Order n.º 345/2016, of December 30th. <-

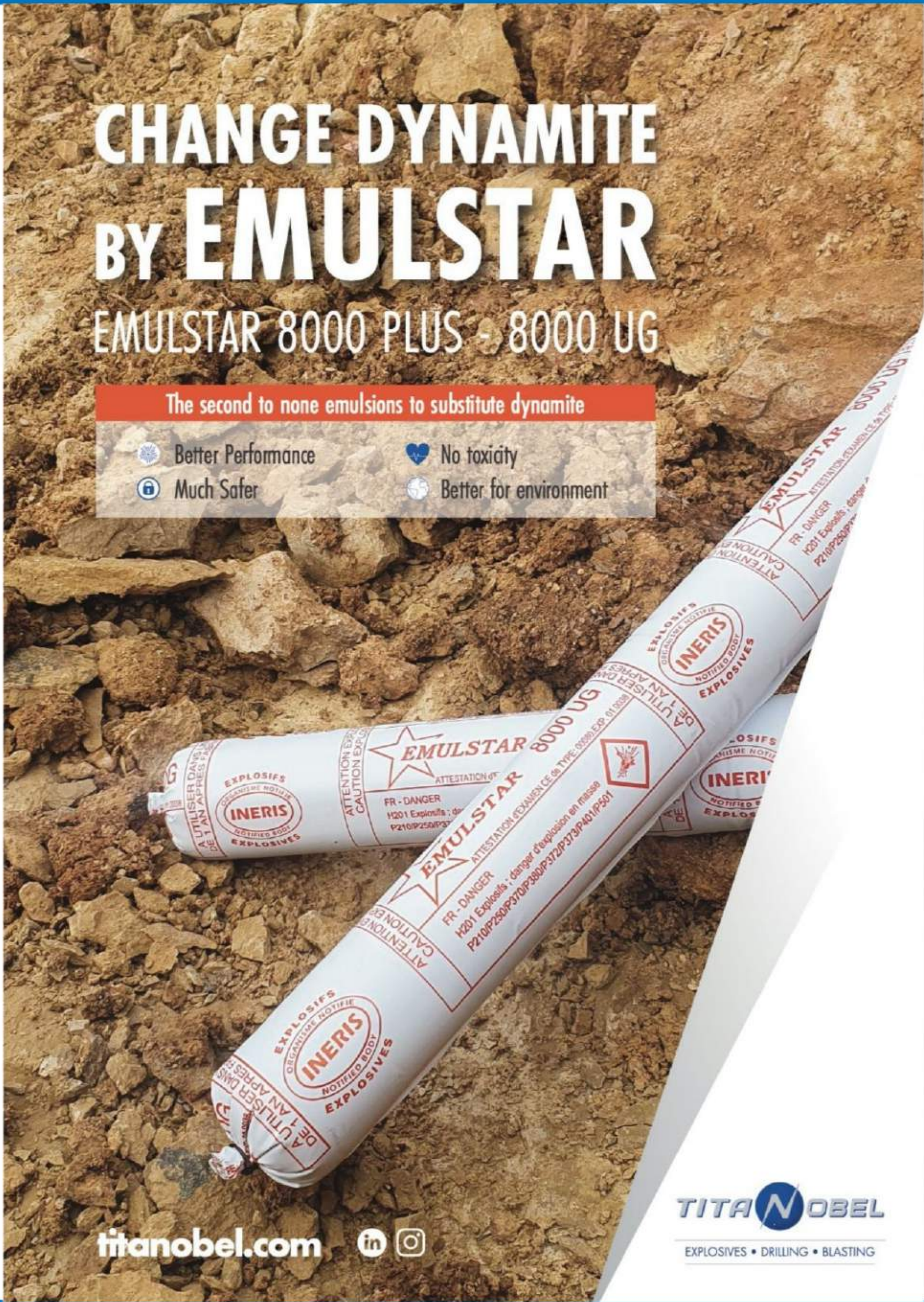
Figure 14 - Example of a verification and inspection action carried out by the Arms and Explosives Department of PSP on an explosives transport vehicle equipped with SIGESTAME.

4. Conclusion

With this approach we intend to show the evolutionary path of security management in transport business of explosives, considering the high complexity of this process resulting from the associated danger and existing threats.

After this analysis we verified that there has been a permanent concern in developing and updating the control and security mechanisms defined.

This concern, transversal to all direct and indirect actors, has enabled a joint work between administrative and police authorities and associations integrating this sector, with the consequent creation of a technological and specific product for the management and control of the transport of explosives - the SIGESTAME.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Testing the constructive strength of a container arranged as a mobile deposit of explosive materials

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Abstract.

Today, due to the diversity of the conditions in which the blasting works are executed, they often require a special organization regarding the transportati on and storage of the explosive goods near the blasting field. If for explosive storage arranged for long-term use such as those of the producers, there are detailed regulations regarding the constructive and security requirement s that they must meet, for the temporary storage facilities, there are not enough details regarding the constructive requirement s that they must comply with. One of the most important aspects taken into account when designing and arranging a mobile explosive depot is the limitation to the maximum of the dynamic action and the throw effect of pieces of material under the pression of an accidental detonation. The paper describes the results obtained after testing a container prototype designed for the storage of explosives. Following the tests performed and the evaluation of the dynamic effects of explosions inside and outside the container as well as the analysis of the measureme nt regarding the pressure generated by the detonation of explosive charges, it turned out that the construction and detonation behavior of the tested container complies with the purpose and safety requirement s for setting up a mobile explosive depot.

1 Introduction

Every year, over 20,000 unexploded ordnance items are found on the Romanian territory, most of them from the First and the Second World War and the specialists from the General Inspectorate for Emergency Situations – IGSU operate in order to destroy them.

Usually, various types of projectiles are found, with different capacities and properties, being situations when over 600 such projectiles were stored during one action.

Because destruction procedures are cumbersome and discovered ammunition must be stored in a safe place - often away from where it was found, and from where, over time, it must be taken to the locations where it is destroyed, arose the need to arrange temporary mobile depots to store ammunition products in the immediate vicinity of the place where those are identified.

Arranging such a mobile depot is a first activity in Romania. Such types of mobile depots like containers are also used by other European armies, but the concept has been adapted to the needs and particularities of their use in Romania [1,2].

The container has been designed and dimensioned for loads that can reach 50 kg. TNT equivalent, 1000 detonators and/or infantry ammunition (cartridges of different calibers, offensive or defensive hand grenades), being armored inside so that it withstands the detonation of a 100 mm explosive projectile containing 1.5 kg of TNT as well as the detonation of a grenade placed outside, at the top of the container.

In order to test the behavior of the container in case of accidental detonation of different TNT type explosive charges - located in different configurations both inside and outside it, in the Polygon - explosives testing facility of INSEMEX Petrosani were made a series of measurements on the pressure level generated by the detonation of explosive charges and the dynamic effects of the pressure on the resistance of the container structure were monitored so that it could withstand and respect the measures regarding the safety and protection distances from the objectives and the human persons placed in the immediate vicinity [3].

2 Previous work

2.1 Construction and arrangement of mobile explosive depot

According to the legislation for activities carried out in quarries or blasting engineering works the explosives can be stored also in mobile metal or concrete niches. The way how these depots have to be arranged is described in a project which follow the legislative requirements regarding the construction and arrangement of explosives depots and need to be approved by authorities [4].

An ISO 1C type container was arranged as a mobile depot so as to allow the storage of both explosives and detonators. The container was divided into two compartments, being armored inside with steel plates - type ARMOR S- 500 of 6.5 mm thickness so as to ensure that it can withstand the accidental detonation of a load of 1.5 kg. TNT equivalent. In the first compartment was arranged a number of 20 boxes having a total storage capacity of 25 kg TNT equivalent, with a quantity of 1.3 kg TNT equivalent per each box, being arranged five boxes by four rows. [5] (Figure 1). The second container compartment was arranged for the storage of unexploded ammunition in quantity up to 25 kg TNT equivalent.

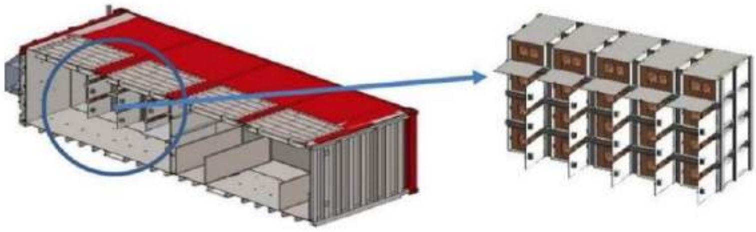


Fig.1. Modification of an ISO 1C container in mobile explosive depot

In the ceiling area, the two compartments were provided with pressure relief and the side walls with slots in order to provide natural air ventilation.

2.2 Test results of the storage boxes placed inside the mobile depot

One of the main targets was to study how the storage boxes withstand to the effects of an accidental detonation in order to ensure the integrity of the container and security in its close vicinity. In this view were established 3 constructive alternatives of storage boxes and tested at the explosion.

TNT explosives and electrical detonators were used in the tests [9,10]. Based on the observed effects of explosion, changes were made to the boxes to increasing their resistance [3].

2.2.1 Test no.1

The explosion resistance of a set of two boxes with a rectangular shape was checked, 1.3 kg of TNT being introduced inside each box, one being initiated with an electric detonator and the other load being used as a control sample (Figure 2 a).

Looking to the blast test results, it was decided to improve the amour steel box construction by welding on its outer edges corner reinforcements and to introduce inside a three compartments wood storage box for better storage and protection of explosives. (Figure 3).

2.2.2 Test no.2

The explosion resistance of a set of two boxes with improved reinforcements was checked, 1.3 kg of TNT being introduced inside each steel box, in the middle of tego wood boxes (Figure 3).

a) Set of two boxes b) First box c) Second box

Fig. 2. Results of blast test

Under the effect of the explosion, the box in which the detonation occurred was completely dismantled (Figure 2 b), the shock wave propagating in the second box dislocating the door and its side wall (Figure 2 c), and the control TNT explosive was disintegrated.

Under the effect of the explosion, in the box in which the detonation occurred the walls were partially dismantled but the explosive control charge from the second steel box was not initiated (Figure 4).

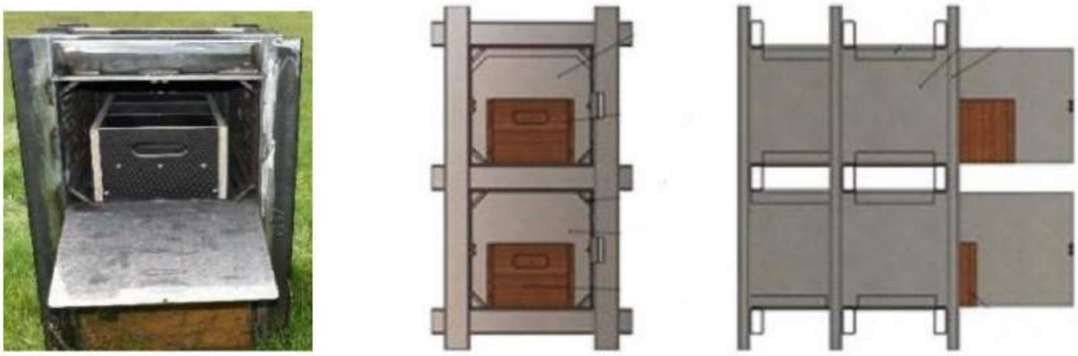


Fig. 3. Arrangement of steel box with stiffening elements and tego wooden box inside

Fig. 4. Effects after testing the steel box

2.2.1 Test no.3

A third constructive variant of a steel box was tested in which an armored metal pipe with a diameter of 406 mm was inserted and inside the pipe a tego wooden box was fixed. The explosion resistance of a set of two boxes with the above- mentioned improvements was checked, 1.3 kg of TNT being introduced inside each steel box, in the middle of tego wood boxes (Figure 5).

Under the effect of the explosion, in the detonation area, the tube wall was broken and the outer wall corresponding to this area was partially dislocated and as well as the door. The box next to the one where the detonation took place was not affected and the explosive charge did not detonate (Figure 6).

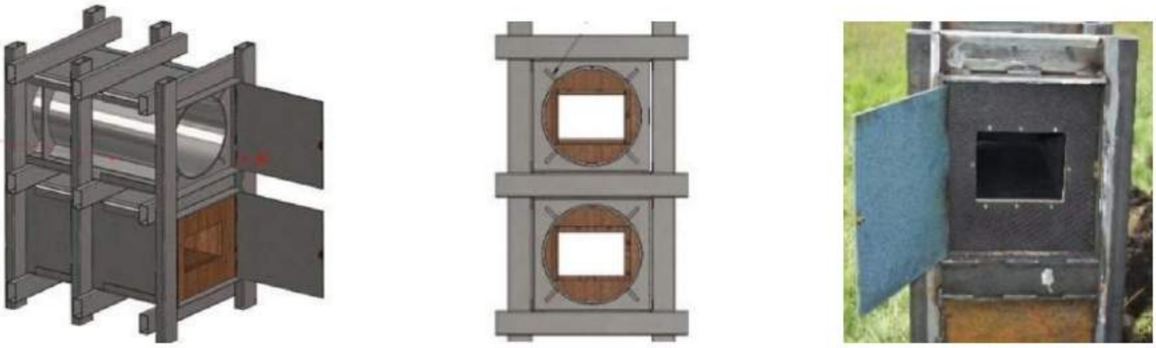


Fig. 5. Arrangement of steel box with inserted pipe and tego wooden box

Fig. 6. Effects of testing the steel box with inserted pipe

2.2.1 Conclusions after the performed tests

Following the evaluation of the results of the test action, it was concluded that the constructive variant with metal pipe inserted in the steel box is the one that confers a superior resistance compared to the other two constructive variants tested.

It has also been established to make some improvements of the steel box in terms of the welding line as well as the stiffening line of the outside box frame, in order to increase its resistance to explosion pressure.

3 Testing the resistance of the container against explosion

Following the establishment of the constructive variant of the box that has the behavior most appropriate to the requirements of the construction of the pyrotechnic container, respectively to withstand the detonation of an explosive load of 1.3 – 1.5 kg. equiv. TNT, without transmitting the detonation outside the box and without initiating other explosive charges in the neighboring boxes fixed in the container, the resistance of the pyrotechnic container (Figure 7) was checked in the Testing explosives field – Polygon of INSEMEX Petrosani.

The metal construction of the container was tested and the explosion pressures were measured [6] when a 1.3 kg TNT load was introduced a detonated in a box in the compartment for storing explosives and detonators (Figure 7 a), 1.5 kg.

a) Storing explosives

b) Storing unexploded ordnance

c) outside of the container

Fig. 7. Arrangement of pyrotechnic container for testing in the Polygon

TNT load detonated inside the compartment intended for storing unexploded ordnance (Figure 7 b), respectively detonating an explosive charge of 0.100 kg TNT, located on the outside of the container (Figure 7 c).

3.1 Container testing no. 1 - 1.3 kg. TNT placed inside of a steel box

3.1.1 Test input data

- detonation of an explosive charge of 1.3 kg. TNT placed in the steel box located in the middle of the second row of the first compartment dedicated for the storage of explosives and detonators (Figure 8);

- placement of a pressure sensor outside the pyrotechnic container – sensor SP 4, facing the access door in compartment no.1, at a distance of 2.0 m from it and collinear with the explosive charge (Figure 9).

Fig. 9. Container test no. 1 - arrangement of the 4 pressure sensors

Fig. 8. Location of the explosive charge in compartment no. 1 of container

- placement of 3 pressure sensors inside the pyrotechnic container, in compartment no.1, one in the area of the vent located on the right side of the access door – sensor SP 1, another one on the left side of the access door – sensor SP 2, both in a direction perpendicular to the metal boxes and the third one – sensor SP 3, positioned in the upper left corner of compartment (Figure 9);

3.1.2 Measurement results

Visualization of the air pressure wave for the 1.3 kg TNT test, located inside the steel box from compartment no. 1 of the pyrotechnic container - fast video shooting at 9000 frames per second, is presented in the screenshots from Figure 10.

Fig. 10. Visualization of detonation and air shock wave propagation test no. 1

The appearance of the air shock waves for the explosive charge of 1.3 kg. TNT are shown Figure 11.

The maximum measured values of the overpressure at points SP1, SP2, SP3 and SP4 are shown in Table 1.

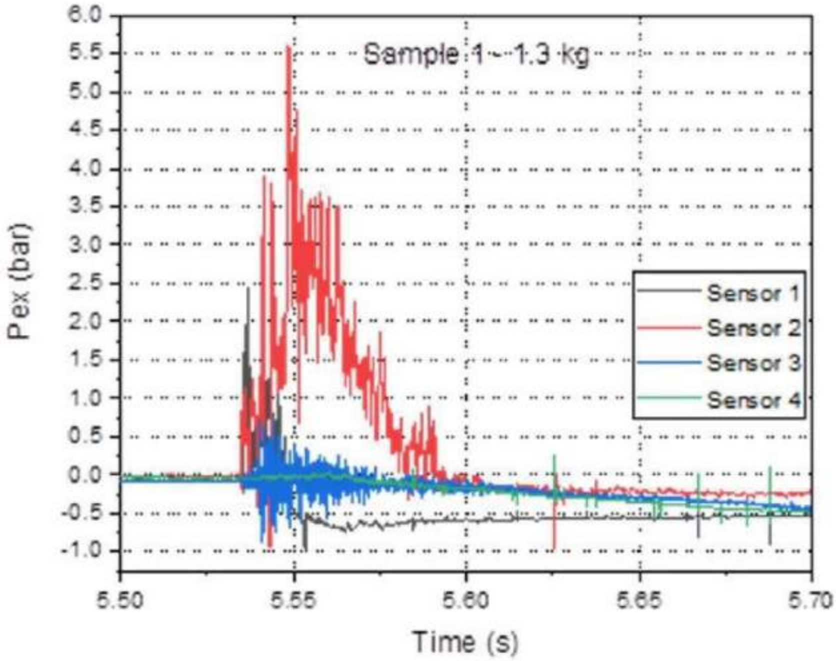


Fig. 11. Representation of the overpressure in time interval 5.50 – 5.70 s, test no. 1

SP_1 - int. (bar)	SP_2 – int. (bar)	SP_3 – int. (bar)	SP_4 – ext. (bar)
2,44740	5,59507	0,77329	0,28065

Table 1. Measured values of overpres sure test no.1

3.1.3 Dynamic effects following the detonation of the explosive charge

Following the detonation of the 1.3 kg TNT load, placed inside a steel box in compartment no. 1 of the pyrotechnic container, the following were found:

- a deformation of the access door in the compartment and of its supporting frame (Figure 12a) as well as a slight deformation of the container wall, on the opposite side of the access door;

- the two pressure relief devices related to compartment no. 1 were operated following the detonation and were projected at distances of over 30 - 40 m (Figure 12 b);

- under the dynamic effect of the detonation, the doors of the boxes were opened, some with broken hinges (Figure 12 c), the door corresponding to the box in which the detonation took place being torn off;

- the cylindrical walls of the box in which the detonation took place were broken, but the shock wave did not propagate to the neighboring boxes, the explosive control introduced in the box next to the detonated one, not being initiated.

3.2 Container testing no. 2 - 1.5 kg. TNT introduced into the compartment for the storage of unexploded ordnance

3.2.1 Test input data

- detonation of an explosive charge of 1.5 kg. TNT suspended from the ceiling in the middle of compartment no. 2 of unexploded ordnance storage and at a distance of 1.0 m from the ceiling (Figure 13 a);

- placement of 3 pressure sensors inside the pyrotechnic container, in compartment no.2, one in the area of the vent located on the right side of the access door – sensor SP 3,

a) Container outside deformation *b) Pressure relief devices after blast* *c) Effects on the inside boxes*

Fig. 12. Dynamic effects in compartment no. 1

another one on the left side of the access door – sensor SP 5 and the third one – sensor SP 6, located on the upper right- side wall of the container, sensor in the direction perpendicular to the suspended explosive charge (Figure 13 b);

a) Suspended charge of 1.5 kg. TNT

b) Arrangement of the 4 pressure sensors

Fig. 13. Container test no. 2 - location of the explosive charge and arrangement of the 4 sensors

- placement of a pressure sensor outside the pyrotechnic container – sensor SP 4, facing the access door in compartment no.2, at a distance of 2.0 m from it and collinear with the explosive charge (Figure 13 b).

3.2.2 Measurement results

Visualization of the air pressure wave for the 1.5 kg TNT test, suspended inside of compartment no. 2 of the pyrotechnic container - fast video shooting at 9000 frames per second, is presented in the screenshots from Figure 14.

The maximum measured values of the overpressure at points SP3, SP4, SP5 and SP6 are shown in Table 2.

SP_3 - int. (bar)	SP_4 – ext. (bar)	SP_5 – int. (bar)	SP_6 – int. (bar)
3,10843	0,72097	7,84792	13,75198

Table 2. Measured values of overpressure test no. 2

The appearance of the air shock waves for the explosive charge of 1.5 kg. TNT are shown Figure 15.

Fig. 14. Visualization of detonation and air shock wave propagation test no. 2

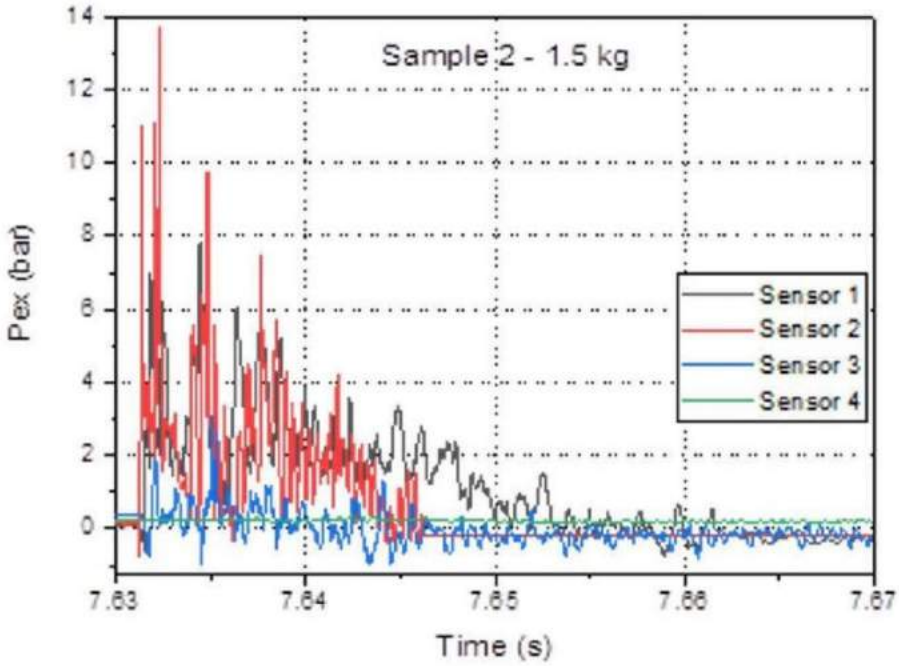


Fig. 15. Representation of the overpressure in time interval 7.63 – 7.67 s, test no. 2

3.2.3 Dynamic effects following the detonation of the explosive charge

Following the detonation of the 1.5 kg TNT load, suspended inside of compartment no. 2 of the pyrotechnic container, the following were found:

- a deformation of the access door in the compartment and of its supporting frame (Figure 16 a) as well as a slight deformation of the container wall, on the opposite side of the access door;

- the two pressure relief devices related to compartment no. 2 were operated following the detonation and were projected at distances of over 40 - 60 m (Figure 16 b);

- welding failure in the area of the support beam of the ventilation system located at the ceiling of the compartment, as well as the sectioning of the hinge clamping system between the compartment door and its support frame (Fig. 16 c).

a) Container outside deformation *b) Pressure relief devices after blast* *c) Effects in the acces door area*

Fig. 16. Dynamic effects in compartment no. 2

3.3 Container testing no. 3 – 0.100 kg. TNT suspended in front of the container

3.3.1 Test input data

- detonation of an explosive charge of 0.100 kg. TNT located outside the pyrotechnic container, on the right side of the access door in compartment no. 1, suspended on a support, at a height of 1.5 m and at a distance of 0.5 m from the wall of the pyrotechnic container (Figure 17 a);

- placement of 3 pressure sensors outside the pyrotechnic container, one in the area of the vent located on the right side of the access door in compartment no. 1 – sensor SP 1, another one on to the right of the access door in compartment no. 2, in the top corner – sensor SP 2 and the third one – sensor SP 3, located to the left of the access door in compartment no. 1, in the top corner (Figure 17 b);

- placement of a pressure sensor outside the pyrotechnic container – sensor SP 4, facing the access door in compartment no.1, at a height of 1.5 m and at a distance of 0.5 m from it and collinear with the suspended explosive charge (Fig. 17 b).

3.3.2 Measurement results

Visualization of the air pressure wave for the 0.100 kg TNT test, suspended in front of the pyrotechnic container at a distance of 0,5 m from it - fast video shooting at 9000 frames per second, is presented in the screenshots from Figure 18.

a) Outside charge of 0.100 kg. TNT

b) Arrangement of the 4 pressure sensors

Fig. 17. Container test no. 3 - location of the explosive charge and arrangement of the 4 pressure sensors

Fig. 18. Visualization of detonation and air shock wave propagation test no. 3

The appearance of the air shock waves for the explosive charge of 0.100 kg. TNT are shown Figure 19.

The maximum measured values of the overpressure at points SP1, SP2, SP3 and SP4 are shown in Table 3.

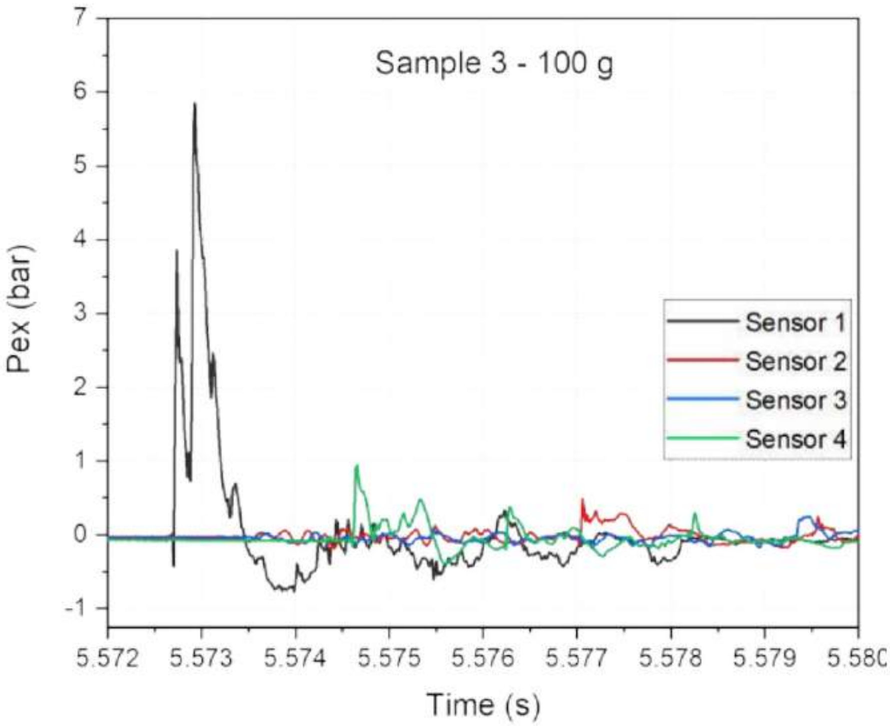


Fig. 19. Representation of the overpressure in time interval 5.57 – 5.58 s, test no. 3

SP_1 - ext. (bar)	SP_2 – ext. (bar)	SP_3 – ext. (bar)	SP_4 – ext. (bar)
5,84847	0,48991	0,2861	0,94659

Table 3. Measured values of overpressure test no. 3

3.3.3 Dynamic effects following the detonation of the explosive charge

Following the detonation of the 0,100 kg TNT load, located outside the pyrotechnic container, on the right side of the access door in compartment no. 1, suspended on a support, at a height of 1.5 m and at a distance of 0.5 m compared to the wall of the pyrotechnic container, only a slight deformation of the container sheet was found near the area where the explosive charge was suspended and initiated.

4 Evaluation of results

4.1 Constructive improvements of the pyrotechnic container

Analyzing the results of the three tests performed with reference to the behavior of the pyrotechnic container with respect to the dynamic action of the explosions, the following improvements were agreed:

- in order to limit the throwing of pressure relief devices under the dynamic action of explosions, a grid protection system shall be mounted above them, on one third of their surface starting from the area of the access doors in the container;

- in order to ensure a better natural ventilation of the pyrotechnic container, the number of holes in the ventilation areas will be supplemented;

- each door from the boxes in compartment no. 1 shall be provided with a safety cable (fixed between the box door and its frame) so as to allow the door to be opened at an angle of 30 o. The safety cable shall be fixed at one end and detachable at the other;

- protection of the area of the locks from the two access doors in the container compartments with a pocket-type protection, similar to those in the area of the ventilation holes made in the walls of the container.

4.2 Discussions on test results

Based on the evaluation of the dynamic effects of the explosions carried out inside and outside the container, as well as the analysis of the measurements regarding the pressure generated by the detonation of the explosive charges, results the following:

- according to the data from the literature [4], the values of the pressure measured inside the container of 3.1 - 13.75 bar obtained when detonating a suspended load of 1.5 kg. TNT in compartment no.2 and 0.77 - 5.6 bar obtained by detonating a load of 1.3 kg. TNT introduced in the box, would have led to the total or partial destruction of the industrial constructions with metal frame, of the concrete or masonry buildings located in the immediate vicinity of the container. Under the conditions specified above and the measured pressure values, the dynamic effects of the detonation on the structure of the tested pyrotechnic container are limited to deformations in the area of the access doors, the failure of some welding lines inside compartment no. 2 or remote throwing of pressure relief devices. At the same time, the constructive arrangement and the detonation behavior of the explosive storage boxes, ensured the integrity of the explosives in the boxes adjacent to the one where the detonation took place.

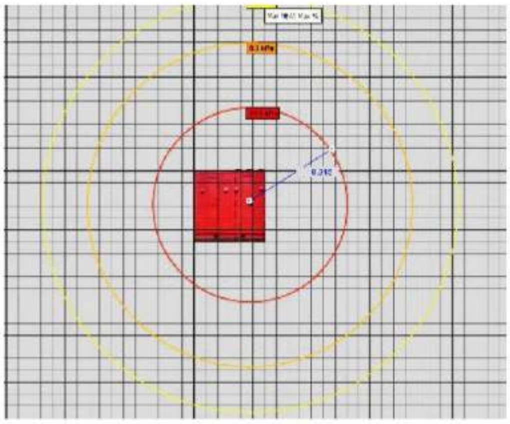
- according with specific national legislation and worldwide literature [4,7], the values of the pressures measured outside the container with a value of 0.28 bar when detonating a load of 1.3 kg. TNT introduced in the box and 0.72 bar when detonating a suspended load of 1.5 kg. TNT in compartment no. 2, can lead to injury to the human factor placed close to the container. The values measured outside the container, of the pressure produced by the explosion come from the dissipation of the pressure waves through the pressure relief devices mounted on the roof of the container.

By using a specialized software application - IMESAFR, it was possible to make a probabilistic assessment of the risk situations generated by the detonation of explosive charges in the two compartments of the container and the pressures generated outside it, in order to determine the level of safety or the corresponding degree of insecurity. Thus, in Figure 20 – a , show the mortality zone estimated to be within a radius of 8 m, in Figure 20 – b , shows the area of major lesions within a radius of 14 m and in Figure 20 – c , shows the area of minor injuries within a radius of 17 m around the container.

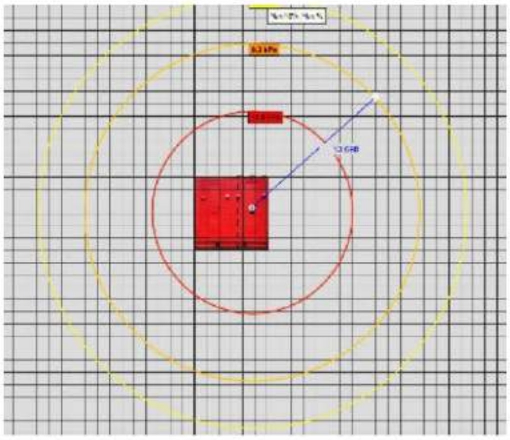
5 Conclusions and recommendations

When designing a mobile explosive depot, it's important to reduce at the maximum the dynamic action and the throw effect of pieces of material under the pressure generated by an accidental detonation.

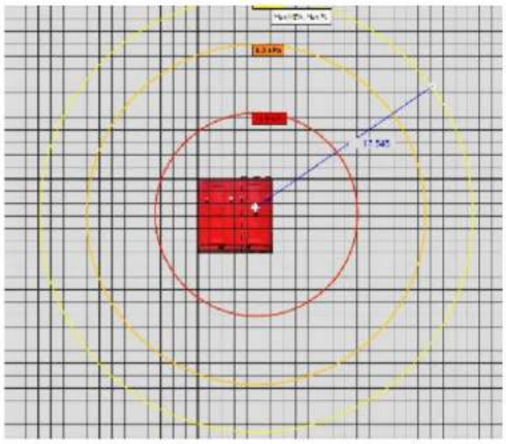
The resistance of a pyrotechnic container was tested in the Explosives Polygon of INSEMEX Petrosani and following the tests performed and the evaluation of the dynamic effects of explosions inside and outside the pyrotechnic container, as well as the analysis of the measurement results regarding the pressure generated when detonating explosive charges, it resulted that the dynamic effects of detonation on the pyrotechnic container structure were limited to deformations more in the area of the access doors, to the failure of some welding lines inside the compartment no. 2 and remote throwing of pressure relief devices.



a) Mortality zone – up to 8 m



b) Major lesions zone – up to 14 m



c) Minor injuries zone – up to 17 m

Fig. 20. Radius of shock wave and influence on the human factor

The risk assessment showed that if the container resists the detontion of various explosive charges, the shock wave generated can be dangerous to the human factor. As such, a safety distance of at least 20 from the location of the pyrotechnic container is recommended.

The experience gained in testing the pyrotechnic container can be used and extended in the field of mining and road construction, in order to design and arrange mobile warehouses needed in the activities of blasting companies who are performing works in isolated areas where there are no explosive depots nearby, contributing at the same time when complying with the safety requirements for explosives storage.

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FORCIT

European Federation of Explosives Engineers Council Meeting in Istanbul 11th and 12th November 2022

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The Council Meeting of EFEE took place in Istanbul with attending representatives from the following countries: Germany, Norway, UK, Netherlands, Estonia, Czech Republic, Italy, Sweden, Portugal, Finland, Denmark, Belgium and Romania.

Top of the agenda was the upcoming 12th EFEE World Conference which will take place in Dublin, at the Royal Dublin Society, from the 9th to the 12th of September 2023.

The EFEE World Conference on Explosives and Blasting is one of the key international blasting events, drawing attention from explosives users, manufacturers and drilling equipment operators as well as researchers and professionals involved in the construction and mining industry.

The conference attracts attendees and exhibitors from around the globe – not just Europe - and is a grand event incorporating site visits and a gala dinner which will take place at the Guinness Storehouse. Further details are available at www.efeeworldconference.com or info@efeeworldconference.com

Working hard...

The EFEE newsletter continues to seek contributions, preferably on non-military topics. Articles that have previously been published in other journals may be considered for publication the EFEE newsletter. Promotional articles will also be published for a fee.

The meeting at the EU Commission to discuss relevant regulations has been postponed until January 2023 however any EFEE member wishing to raise questions or lobby the commission may do so via Jörg Rennert.

Women of EFEE. Left to right
Marilena Cardu (Italy), Ruth Barber (UK), Teele Tuuna-Lootus (Estonia), Viive Tuuna (President, Estonia)

Ruth Barber doing her bit for international relations - left to right
Espen Hugaas (Norway), Ruth Barber (UK), Tomi Kouovonen (Finland)
<-

EFEE Board members

EFEE is keen to encourage more members and it is planned to offer a discount on EFEE membership fees to persons who are already a member of their national body. It is also planned to offer discounted three year memberships. Educational entities are also encouraged to become members and details of educational establishments who may be interested in joining are requested.

EFEE continues to co-operate with FEEM, the Federation of European Explosives Manufacturers, especially with regard to standards for track and trace systems.

The EFEE website is in the process of being updated to become more user friendly and a more valuable resource for members.

The next meeting of Council will take place on the 5th and 6th of May 2023 in Berlin.

Due to an increase in EFEE membership, positions have opened up on the EFEE Council for additional representatives, and EFEE members are strongly encouraged to apply. The role will tend to suit people of a non-military background with and interest and experience in European issues and the ability to travel. If any members would like further information about the duties and responsibilities of

joining the EFEE Council please email info@efee.eu

EFEE Council Members in Istanbul

New EFEE members

We would like to welcome the following member who have recently joined EFEE.
Congratulations and a warm welcome for joining EFEE as a member.

Individual Members

Jacopo Seccatore, Adolfo Ibanez University, Pirque, Chile
Ruairi O`Connor, Irish Industrial Explosives Ltd., Roscommon, Ireland
Shaun Carney, Lubrizol Ltd., Derbyshire, United Kingdom
Dónal Clare, Irish Defence Forces, Naas, Ireland
Ibrahim Ayuba, Newmont, Konongo, Ghana

Upcoming International Events

International Conference on Design Methods in Underground Mining ICDMUM
Feb. 1-2, 2023
Melbourne
Australia
https://waset.org/design-methods-in-underground-mining-conference-in-february-2023-in-melbourne

ISEE`s 49th Annual Conference on Explosives and Blasting Technique
Feb. 3–8, 2023
San Antonio, Texas, USA
https://isee.org/conferences/2023-conference

SME Annual Conference & Expo
February 26-March , 2023
Denver, Colorado
USA
https://www.smeannualconference.com/index.cfm/conference/program/

International Conference on Mining Technologies ICMT
May 20-21, 2023
Berlin
Germany
https://waset.org/mining-technologies-conference-in-may-2023-in-berlin

World Mining Congress
June 26-29, 2023
Brisbane, Australia
www.wmc2022.org

EFEE`s 12th World Conference on Explosives and Blasting
September 10th to 12th, 2023
Dublin, Ireland
info@efeeworldconference.com

HILLHEAD 2022
June, 21-23, 2022
Hillhead Quarry
Buxton. UK
https://www.hillhead.com

International Explosives Conference 2022
June 22nd-24th, 2022
Victory Service Club
London, UK
http://www.iec-2022.com/?action=main

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