

**EXPLOSIONS IN THE REPUBLIC OF MACEDONIA  
IN THE PERIOD FROM 2006 TO 2011  
A RESEARCH CONDUCTED IN THE FIREFIGHTING UNITS**

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**Abstract:**

Explosions are a phenomenon that occurs as a result of explosive substances and as a result they bring to a large number of victims and destruction of material goods. Detonation reaction is defined as instantaneous combustion or decomposition at a speed greater than the speed of sound. Explosion is a chemical or mechanical activity that results in a rapid spread of gases. The execution of this type of crime is easy to implement since bombs for the preparation of an explosion contain many common ingredients that are readily available. These include: black gunpowder, nitroglycerin, ammonium nitrate, triacetone triperoxide, trinitrotoluene, etc. Some of them become murderous only if activated by means of an initial explosion which can be: electricity, safety wick, or detonating wire. What is characteristic of the detonating wire is that it can be used to connect a series of explosive charges so that they can detonate simultaneously. The most important step in detecting and analyzing the remains of the explosive substances is the collection of appropriate samples at the site where the explosion occurred. Some undetected remains of explosives almost always remain at the site of the explosion. According to the size of the crater, it is determined whether it is a weak or strong explosion. Remnants of explosive materials can be located in the ground crater or hole where the explosive device or objects located near the detonation is activated.

**Key words:** explosion, detonate, materials, samples, substances.

**1. INTRODUCTION**

The term explosion, in a broad sense, means a very fast physical, chemical, or nuclear process of changing the state of a system, followed by the transition of the potential energy to the

kinetic energy of elementary particles, i.e. in mechanical work.<sup>1</sup> The work carried out during the explosion is conditioned by the rapid expansion or spread of gases that existed or which formed during the explosive decomposition. The process of explosive decomposition is characterized by a quick leak in pressure and temperature in the environment where the explosion is directly caused, resulting in a disruptive or degrading effect of the environment. The blast has a basic specificity, and it is that the only reason for the destructive action is not the quantity of released energy, but the speed at which that energy is released.<sup>2</sup> The energy released during the explosive decomposition process will be spread over a longer period of time, the process would protrude calmly, and it would not cause an explosion.

When describing the phenomenon called an explosion, two phases are distinguished:<sup>3</sup>

- Phase I - converting some form of energy into the energy of strongly compressed gases and
- Phase II - very rapid spread of high - pressure gases.

Based on the nature of the occurrence, the explosions can be: physical, chemical, and nuclear.

## 2. TYPES OF EXPLOSIONS

### 2.1 Physical explosion

Physical explosion is caused by physical phenomena, and explosive substances are currently moving from one physical state to another. A physical explosion causes the following phenomena:

- an explosion of a superheated steam boiler, where mechanical work is performed at the expense of the steam energy generated by evaporation of boiling water (enthalpy), which had the water in the boiler just before the explosion;
- meteor impact, where kinetic energy is converted to heat during abrupt braking, since bodies moving at a speed of 1.5 km/s and greater when braking has a mark on the explosion, as it comes to grilling, melting, and evaporation of these bodies, whereby the surrounding air rises sharply;
- an explosion of a pressure bottle; and
- explosions that occur during electrical discharge under high voltage, such as lightning. Then the air is warming up suddenly, causing pressure increase and sudden expansion, in the form of a shock wave (thunder);
- explosions occurring in the illumination of a matter with very strong light impulses, which can be obtained from quantum generators (lasers);
- tremors with great energy;
- volcanoes;
- creating new stars, etc.

### 2.2. Chemical explosion

The term chemical explosion refers to a self-destructive process of chemical reactions through explosive matter. Due to the high speed of reaction, the process practically takes place in

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<sup>1</sup> Jeremih R., „*Eksplodije i eksplozivni*“, Vojnoizdavački Zavod, Beograd, 2007.

<sup>2</sup> Акаван Ж., „*Хемија на експлозиву*“, Второ издание, АД Вербум, Скопје, 2009, page 21.

<sup>3</sup> Pleše M., „*Fizika i kemija eksplozivnih tvari*“, Ministarstvo obrane Republike Hrvatske, Zagreb, 2008, page 25.

the volume of the explosive itself. When exothermic reactions take place, heat is released and it heats the gas products that are under a very high pressure.

To make the chemical composition be explosive in its characteristics, three basic conditions must be fulfilled:

- exothermic reaction;
- high speed of reaction; and
- creation of gas products.

With these three conditions, the self-destruction factor also arises, which must also be satisfied. The initiated process at one place must be spontaneously transmitted over the entire mass of the explosive substances.

All of the aforementioned factors are not absolute and independent of each other. The high velocity of the reaction is not determined only by the size of the constant velocity, but also by the temperature that occurs during the reaction. Also, the ability for self-dispersion depends on the speed of reaction and the heat effect.

### **2.3. Nuclear explosion**

Nuclear explosions are a consequence of chain nuclear reactions that can take place through fission (division) or fusion (coupling) of the nucleus, accompanied by the release of a very large amount of energy in various emergent forms:

- thermal energy ( $4 \cdot 10^{13}$  -  $4 \cdot 10^{18}$  kJ/kg);
- mechanical energy;
- energy in the form of radiation.

## **3. FEATURES OF EXPLOSION – REACTION TO DETONATION**

The reaction to detonation can be defined as instantaneous combustion or decomposition at a speed greater than the speed of sound. Effects of explosion or detonation are: impact, pressure boosting phase, shock wave, pressure reduction phase, spray effect, ignition effect and radiation effect. Detonation is a process of supersonic, i.e. supra-spatial layering of the front of chemical transformations through explosive substances. It is the stationary and most perfect form of an explosion. The rate of detonation appears as a constant and is one of the most important characteristics of explosive substances.

Chemical conversion of explosive substances during detonation unconditionally follows the movement of the environment as a consequence of the differences in the specific volumes of the unbundled explosive substances and products of detonation at the same pressure. As the movement of the environment is carried out in the direction of movement on the front of the detonation, this also affects the speed of chemical conversion.

This means that detonation is not only a chemical but also a hydrodynamic process; according to the same theory, the transfer of detonation is conditioned by the propagation of the shock wave after the explosive matter. If the amplitude of the front of that wave is greater than certain critical values, then that wave is capable of causing an intense chemical reaction from which the energy is released (heat) that constantly supports the wave parameters and the stationary mechanism of the entire detonation process.

As a reaction to detonation, very strong forms of action occur in the place of the explosions and cause the rupture as a result of the explosion. The brilliant action of the blast is what is

happening in the very center and in the immediate vicinity of the center of the explosion. It can be:

- the action of the gaseous products with high temperature;
- the action of very strong shock waves generated in high density environments located at the very center of the explosion (directly with the explosive substance);
- acting on the flow of solid materials located in the very center of the explosion;
- a crushing action of the solid materials that are at the very center of the explosion.

The crushing action of the explosion is a consequence of the spread of shock waves caused by the rapid expansion of the gaseous products of the explosion and their suppression in the middle. The propagation of the shock wave, and thus the forms of its slashing action, depend very much on the environment in which the shock wave extends. This is enabled by the analysis of energy dissipation, which is provided by each environment. This means that the crushing action depends on the total energy losses that are irreversible.

### **3.1. Research of explosion at the Territorial Fire Fighting Units on the territory of the Republic of Macedonia in the period from 2006 to 2011**

Explosion research in the Republic of Macedonia is based on statistical data, which is based on the data structure that gives the general picture of the explosions, the causes, the material damages, the consequences for the life of the people and the environment. The data processing methodology is based on the selection of a group of indicators that lead to explosions that show the vulnerability of people, homes, the working environment, the environment, material damages, environmental problems, as well as the creation of policies related to security, criminal politics, environmental protection, etc.

The application of the quantitative method is significant especially for research where there are mass phenomena such as processes and forms of explosions involving competent state authorities and other organizations. This method is correlated with the phenomena, structures, prevalence, intensity, frequency, etc.

The results obtained in surveys using a quantitative method are reported numerically in the form of tables, graphs, sketches or maps. The advantage of quantitative analysis in terms of qualitative is in the clearer, simpler and more complete explanation of the researched phenomenon. This method allows for a systematic discussion of a number of causal factors through the determination and statistical examination of the relationships that make up the research problem.<sup>4</sup>

This method also enables the production of permanent records by computer processing of collected data, precise processing and interpretation of data for a given period of time. The quantitative data are the result of regular annual statistical processing of the Territorial Fire Fighting Units (TPPE) of the Republic of Macedonia. The Republic of Macedonia with its area of 25.713 km<sup>2</sup> and the number of inhabitants 2.022.547, based on the data from the 2002 census, is divided into eighty urban and rural municipalities.

The methodological aspects of the research of explosives processed the necessary data from the books on the records of the explosions, the explosion statistics for the fire brigade of the city of Skopje and the Territorial Fire Fighting Units of the municipalities in the Republic of Macedonia for the period from 2006 to 2011. The results of the conducted research are presented in the form of tables with numerical data and in the form of graphs.

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<sup>4</sup> Стојчев В., „Методологија на воените науки“, Воена академија „Генерал Михаило Апостолски“, Скопје, 2004.

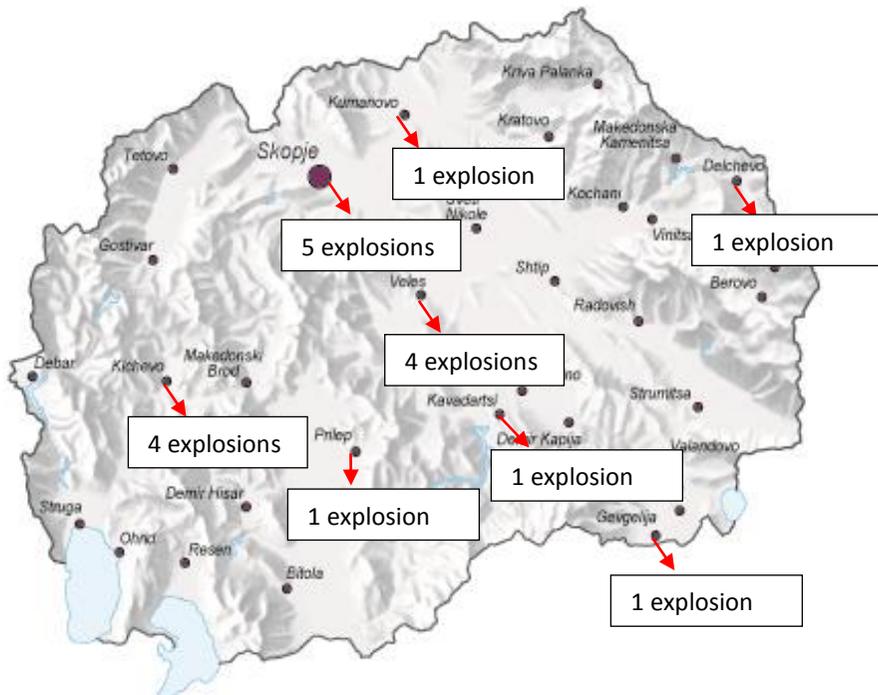


Figure 1: registered explosions on the territory of the Republic of Macedonia

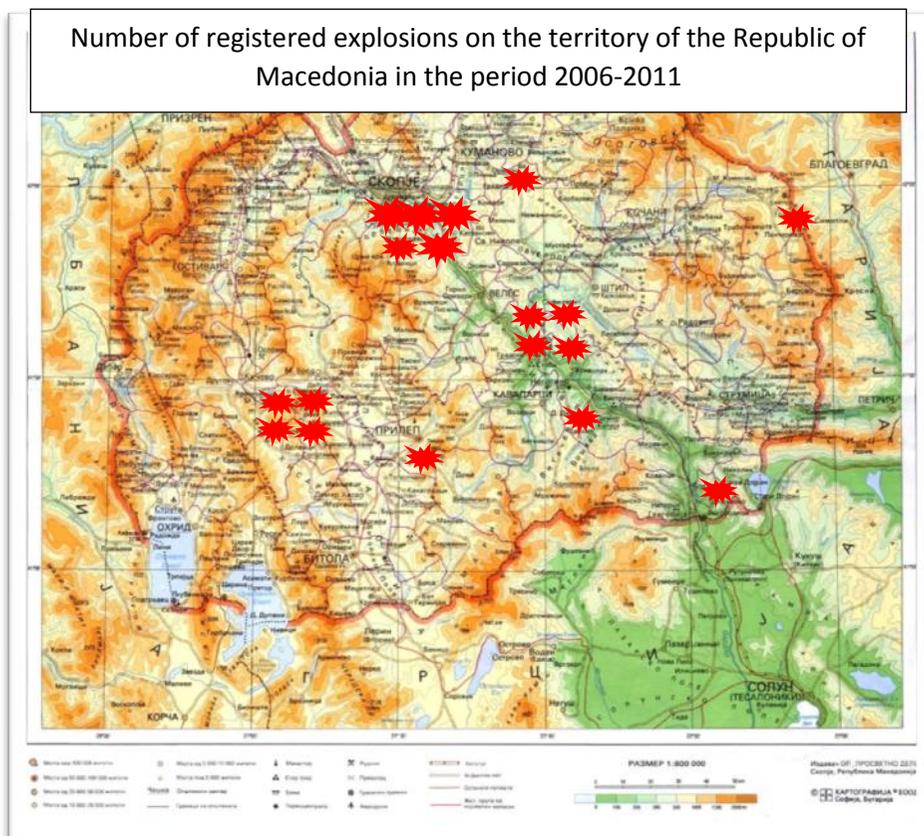


Figure 1a:

★- registered explosions on the territory of the Republic of Macedonia in the period 2006-2011

Figures 1 and 1a present the events in the Republic of Macedonia that are registered as an explosion. During the research period, the territorial firefighting units covered the entire territory of the Republic of Macedonia. The data processing methodology is based on the application of the quantitative method, i.e. the use of the overall data, which are correlated with the phenomena, structures, intensity, distribution and frequency of the same from the aspect of the Territorial Fire Brigade in the Republic of Macedonia.

If the map is analyzed of registered events, taking into account the causes of explosion occurrence, it can be noted one structure of events that is not closely related to the crime rate in a certain part of the state, density of population, technical and technological development of region, etc.

Figures 2 and 2a present Number of explosion per year. Compared to years, the most recorded explosive events in years were in 2010 - 7 explosions, in 2007 - 4 explosions, in 2009 - 3 explosions, in 2011 - 2 explosions, in 2006 and 2008 - one explosion.

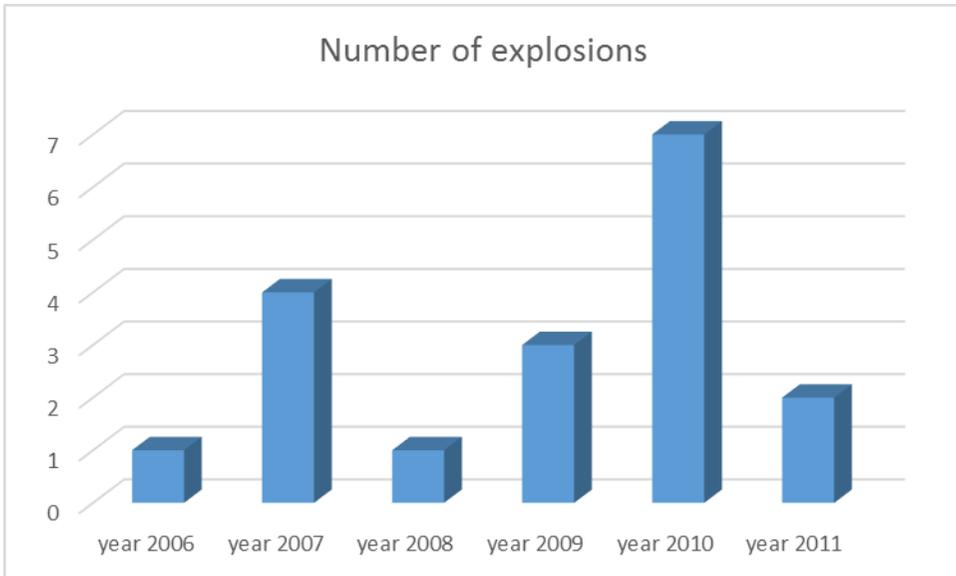


Figure 2: Number of explosions per year

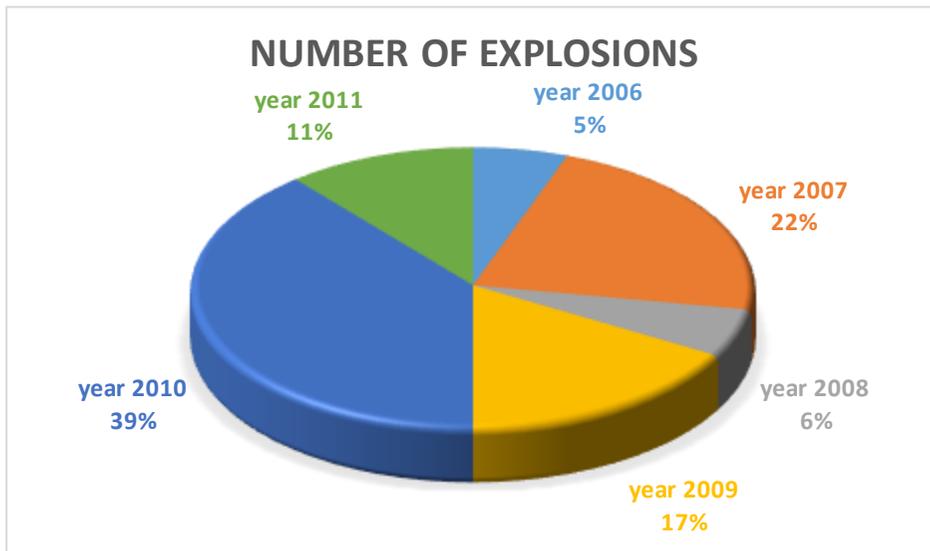


Figure 2a: Number of explosions per year - pie chart (in percentages)

In the following diagrams, i.e. in the conclusion of this paper, the ratio of the caused explosions in the Republic of Macedonia, i.e. the manner in which they were caused, is shown. The number of those which were accidentally caused, unlike those that were caused deliberately, is high.

Also, the number of victims and injured persons and the type of damages of the objects i.e. facilities and motor vehicles that have occurred as a result of the explosions are shown.

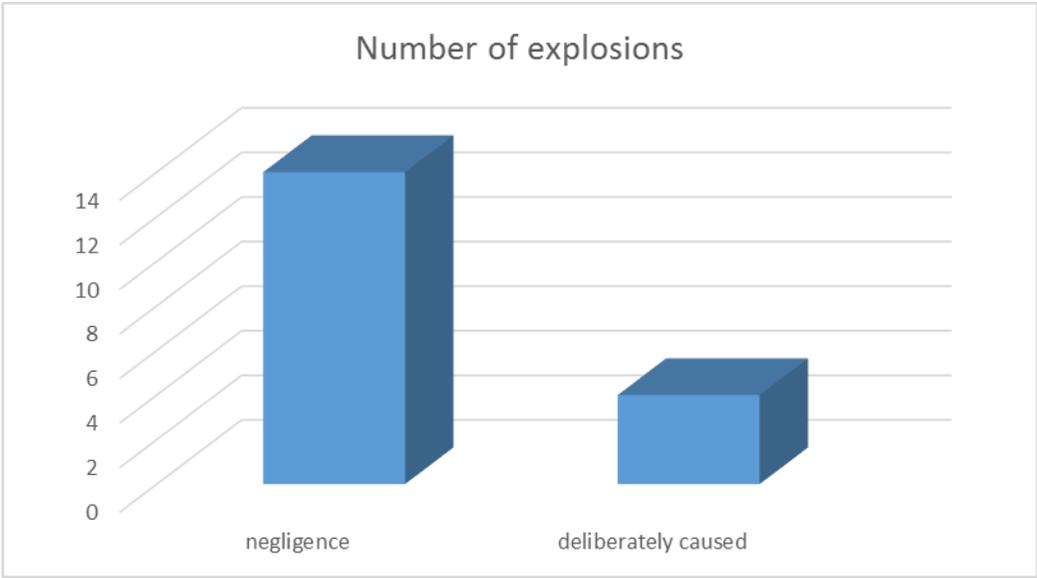


Figure 3: Number of explosions caused deliberately and caused of negligence

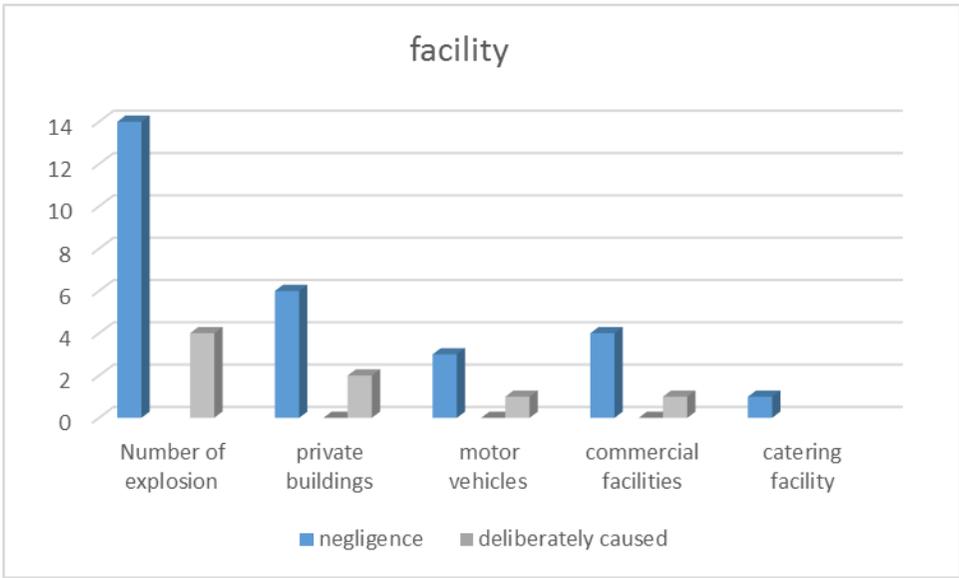


Figure 4: Number of explosions caused deliberately and caused of negligence occurred in deferent facility and motor vehicles

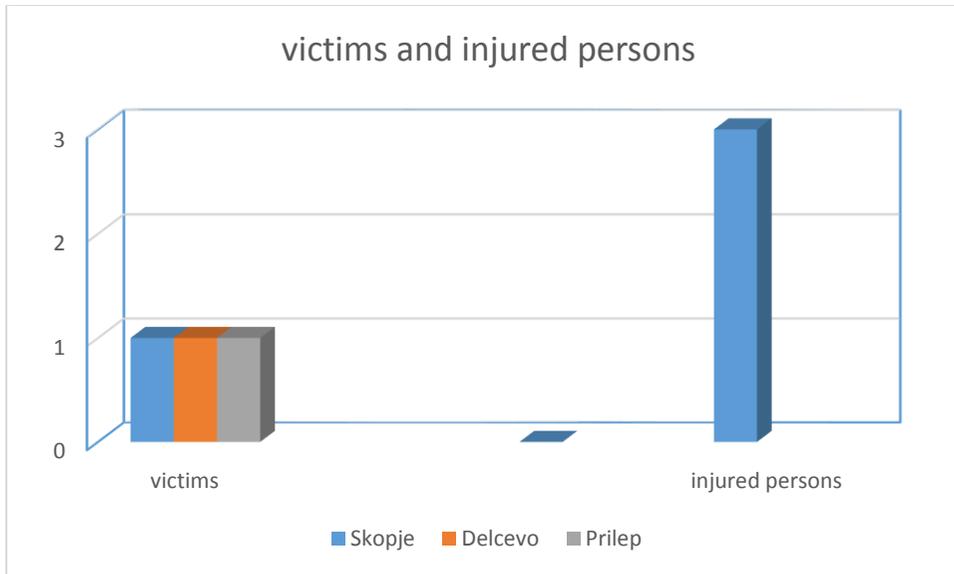


Figure 5: Number of injured persons and victims of explosions on the territory of the Republic of Macedonia in the period 2006-2011

#### 4. CONCLUSION

From the conducted survey of the Territorial Fire Fighting Units in the Republic of Macedonia, we can conclude the following:

1. 18 explosions occurred on the territory of the Republic of Macedonia. There were 14 recorded injuries of negligence, 77,77% and 4 deliberately caused or 22,23%.

2. The survey found that of 4 deliberately caused explosions, 2 or 50% were incurred on private motor vehicles, 1 or 25% occurred on an economic facility in order to cause great material damage, which will later be compensated by insurance companies and 1 or 25% is caused by a private object (basement room) when detonating a device with a certain amount of explosive charge. Of the occurred blasts of negligence 14, 6 or 42,85% were recorded on private buildings, 3 or 21,42% were recorded on explosions of motor vehicles, 4 or 28,57% explosions of commercial facilities and 1 or 7,14% of the resulting explosion is recorded at a catering facility.

3. Of the total of 18 explosions occurred, 7 were in private housing units or 38,88%, 5 explosions were caused on motor vehicles and commercial facilities or 27,78% and 1 explosion occurred on a catering facility or 5,56%.

4. According to the years of explosion, most explosions 7 or 38,88% occurred in 2010, while in 2006 and 2008 there were 1 explosion or 5,56% in relation to the total number of explosions that occurred.

5. As a result of the explosions that occurred, 3 persons received bodily injuries, while 3 people were victims.

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