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IMPROVISED CHARGES PLACED ON UNMANNED AIRCRAFT

Abstract. Improvised explosive device (IED) is an explosive, which is constructed and used in ways other than in conventional military actions mainly by terrorist groups. This article deals with the types, designs and possible applications of IED, focusing primarily on possibilities of attacking the air transport industry. It also describes the danger of deploying unmanned aircraft- drone carrying IED near airports and airport buildings with intention to cause damages.

Keywords: Improvised Explosive Device, airport, types of IED, IED effects, unmanned aircraft.

IMPROWIZOWANE ŁADUNKI WYBUCHOWE PRZENOSZONE PRZEZ BEZZAŁOGOWE STATKI POWIETRZNE

Streszczenie. Improwizowane urządzenia wybuchowe (IED) są konstruowane i wykorzystywane w sposób inny niż konwencjonalne działania zbrojne, głównie przez grupy terrorystyczne. W tym artykule omówiono typy, budowę i możliwe zastosowanie IED, koncentrując się przede wszystkim na możliwościach ataku w branży transportu lotniczego. Opisano ponadto zagrożenie związane z rozmieszczeniem bezzałogowych stat-

ków powietrznych - dronów przenoszących IED, w pobliżu lotnisk i budynków portów lotniczych z zamiarem spowodowania szkód.

Słowa kluczowe: improwizowane urządzenia wybuchowe, lotnisko, rodzaje IED, efekty IED, bezzałogowe statki powietrzne.

Introduction

The economic process, aided by political economic changes aiming towards worldwide globalization of goods production is at the same time accompanied by the globalization of transportation infrastructure. Today, air transport is one of the safest modes of transport. Still, the civil airports might be a suitable target for the perpetrators of terrorist acts, thanks to its concentration of economically stronger passengers. Therefore, the secured interests can be significantly threatened, starting with thefts, kidnaps, fire and some other dangers arising from criminal or terrorist attacks. The nature and seriousness of these crimes changes gradually over time. They use available hi-tech tools to increase the efficiency of their actions. One of these modern instruments is also unmanned aircraft, otherwise known as drone. At the same time, perpetrators respond to precautions undertaken in order to ensure the transportation security.

Civil airport is defined as a territorially circumscribed and in an appropriate manner leveled area, including a complex of buildings and facilities, that is permanently intended for the take off and landing of the civil aircrafts.

The security level at the airport is one of the significant actors while considering the suitability of its usage by airlines and this has a significant economic impact on a given airport. The protection of civil aviation forms a part of the national security programme of every state. Improvised Explosive Devices represent one of the possible threats to airport safety.

Categories of improvised explosive devices (IED)

An IED consists from a system of functional elements that can under some given circumstances, threaten the security of persons or property. Generally, it is a system using mechanical, explosive, incendiary, noxious, radioactive and other materials, or their combination. Mainly, an IED is composed of an explosive device, explosive or incendiary fill and is commonly placed in a container or its exterior is of such form that can hide the real function of the device. IEDs fall into two categories: tactical and strategic. The tactical IEDs are designed primarily against physical persons and incorporate nail bombs, mines or bombs placed in drains, cable covers, shafts etc. The strategic IEDs are designed to draw attention e.g. at the airport, shopping malls, aircrafts etc.

In simulated attacks, IEDs can be used in order to gain credibility for the attack threat. After establishing his/her credibility, the perpetrator can continue in further intrusion without destroying anything, by means of placing well-made but harmless imitations. The unknown ratio of harmless and destructive IEDs keeps busy the security authorities and therefore makes them unable to fulfill other tasks.

Effects of IED

Primary effects of IED

What is usually referred to as primary effects of IED is the direct action of explosion on objects and persons (pressure wave, shock wave, seismic wave and high temperature). The explosion acts on the environment by means of consequent expansion of waste from explosive transformation. However, in a case when a large amount of explosive material is involved (dozens kilograms), the seismic wave must be taken into account (ground vibration), because it may damage the buildings.

Secondary effects of IED

Secondary effects originate in the effects of explosion itself on persons or object. The secondary effects of IED are following:

- Shell effect originates in the explosion pressure wave affecting the container of IED and the objects in the explosion surroundings. The container and some other objects fall into small pieces (shells - fragments), that are speeded up by the pressure wave and if hitting the human organism they could cause injury, or death.
- Fall of loose objects on the objects in the explosion surroundings as a result of pressure or seismic wave caused by the IED explosion. Regarding the fact that the pressure wave spreads in all directions, the insufficiently fastened objects and those located in heights can be thrown down. Particularly dangerous are the objects with a board shape (e.g. glass panels used as a siding) that do not necessarily fall in vertically downwards direction but can glide and thus the impact point does not have to be the same as the fixing point.
- Damage of lines and tanks – electrical, water, vapour, gas, furnace oil, oil, petrol, paints, thinners etc. is caused by heat action, pressure and seismic wave that originate in the explosion and can affect these lines and tanks. In case of any larger explosion a check of all lines and tanks located underground must be carried out in order to prevent possible consequent damages, especially ecological.

- Fire is caused by action of the heat, which is released in the explosion, on easily incentive substances.
- Panic is caused by the action of explosion on the human psyche. A human being when panic-struck is not able to think reasonably and all his/her actions are driven by self-preservation principle. In such case he/she acts regardless of other people. In the course of panic several injuries can occur, or eventually people might be killed e.g. trodden down.

For the risk assessment it is possible to use many existing computer based programs, for example EMOFF (Emergency Office). This program was designed in order to support the planning analysis and provide solution for extraordinary events and crisis situations. The properties of this system stem from the process analysis in the crisis management and from the estimated requests regarding the information security and ensuring the continuity of operation system. A set of software tools EIS/SIM is another program, which contains basic information system for the crisis management EMOFF and simulation upgrade that is capable to create scenarios, further proper simulation functions above the basic information system and enables to evaluate the existing courses of simulation. Another program called RISKAN that was developed for risk assessment using the qualified estimation for security solution of an organization, should be mentioned. VŠB TUO, FBI owns a license for the TerEx program. It is a tool that enables quick prognosis of impacts and consequences, caused by dangerous substances or explosive devices namely when categorically abused, however its accuracy is not always on satisfactory level and results are overdesigned. TerEx model was created as a computer program with concurrence on graphic information system and directly displaying the results on maps. The extent of explosion and threat to environment can be assessed on condition the type of IED and estimated quantity of explosive substance is entered and an analysis is carried out. TerEx was designed especially for operative use during an intervention where quick assessment of threat and realization of consequent precautions regarding the protection of inhabitants, are needed. It can be used directly on spot by chief of intervention or by operating officer at the control centre. It is possible to carry out applications using the exact explosive, conditions a weight of dangerous substance. Nevertheless, regarding the inaccuracy of the TerEx computer program technical discussion is held concerning its use and in connection with this discussion the producer of the program was addressed.

In the future, correction of its parameters is supposed. As an example using TerEx application it is possible to set an IED containing some unknown explosive weighting 5kg, placed in a plastic bag. According to this program, detonation of such device in the departure lounge causes above all building damage that will require evacuation of persons in the range above at least 21 meters. In case of explosion in the open-air area evacuation or concealment of persons out of the reach of shells of at least 516 meters is recommended.

Components of IEDs

The basic components of IED are

An initiation system, trigger mechanism

The initiation systems of IED are based on different mechanical systems, which react to tension, pressure, concussions, heat, radio signal, along with different variations of time-related mechanisms (alarm clock, kitchen timer, digital time system) and various types of industrial fuse and combinations of these systems are used. Factory-made or homemade systems that use the chemical reaction of diverse substances and mixtures corrupting the retention mechanism of the trigger belong to less usual. The initiation systems can be further divided according to time, sensibility to outer stimulation and possible combinations.

Container of IED

IED systems are transported or conserved mostly in various containers. In most cases they are pipes and tubes (using gunpowder and simple fuse they can become a lethal weapon, both explosion and shells), cases, plastic soapboxes, cigarette packets, cigar boxes, glass bottles, tins, cans, electric appliances (irons, toasters, radios), fruit baskets, containers with magnets for easy grip, parcels, playing cards, projectile and cartridge shells, bins (functioning as additional IED container), stone containers, flower vases etc.

Explosive fill

Explosive substances can exist as high explosives (military, commercial or homemade), explosives (standard or homemade), propellants (variations of gunpowder) or explosive gases (propan-butan, acetylene etc.) Most usually following kinds are used:

Nitrate-based Explosives

These are a mixture of ammonium nitrate and oil. Several other explosives are used in the initiation (TNT, RDX, HMX, TE, picrate, amatol, ammonal etc.)

Chlorate-based Explosives

These are a mixture of potassium chlorate and sugar mixed with aluminium in powder. Any standard electric fuse or ignition fuse should be sufficient for initiation.

Peroxide-based Explosives

This is an explosive called HMTD – Hexamethylene triperoxide diamine that can be made of easily accessible materials (hexamethylenetetramine – urotropine, hydrogen peroxide and citric acid).

Improvised ignition substances

We are dealing with petrol, kerosene, diluents, alcohol, carbon disulphide, thinner, varnishes, acetone, wax, potash, glycerin, cellophane, hypergolic mixtures, propane-butane, FAE system, swarfs etc. These materials can be stored in different plastic boxes, which might be equipped with magnets and ignited with incendiary composition or different initiation agents.

Hypergolic mixture

This mixture is made of substance that burns or detonates when put in contact with another substance therefore no fuse is needed. Rags soaked with the motor oil are subject to rapid ignition in the presence of sulphuric acid. This reaction is even faster when added potassium nitrate. It is possible to create a different mixture when dissolving ammonium nitrate in water, where torn pieces of newsprint are added. This pulp, when dried up, is highly reactive with sulphuric acid.

Fuel-air Explosive (FAE)

The principle of IED based on FAE consists in dispersal of appropriate liquid hydrocarbon into air, where heterogenous explosive mixture detonating in certain time period is formed. During the explosion oxygen is used for fuel oxidation and therefore the energy released in comparison to fuel weight is significantly higher than with any other standard explosives.

The advantage of FAE usage is its ability to penetrate the non-airtight objects, to take shape along the terrain contours and go well beyond the terrain obstructions. Particularly advantageous are the conditions formed in closed objects where it causes serious damages to supporting structures.

Types of IEDs

Following types of IED could be suitable for use at the airport:

Pipe bomb

This explosive device is widely used in many countries. Its main characteristics are: the good availability of components, easy preparation and considerable variability of use. This explosive device is mainly a steel or cast-iron pipe filled with explosive material, where one end of the pipe is sealed and the other one ends with a holed screw cap through which the explosive pulse is brought. Particularly important for explosive effect is the pipe size, quantity of explosive material, type of used explosive and pipe wall thickness. When using high explosives such as RDX, PETN or TNT along with suitable geometry, a large amount of shells is produced that have considerable energy and therefore destructive effect on the environment, in particular persons, vehicles, building equipment etc.

Nail bomb

The surface of the explosive charge is covered up to two layers of nails that are fastened with sello tape, adhesive or differently. The nails accelerated to a high speed act as grenade shrapnels with similar consequences. This type of IED is often used in suicide attacks, especially in places with a large number of people.

Shrapnel bomb with rectified effect

The shape of shrapnel bomb is similar to pipe bomb. The iron pipe is equipped with an ignition, propellant explosive (smokeless or black powder) and one end is covered with a layer of small stones or scrap-metal. This end is tightly sealed too. After initiation of propellant charge the expansive force shoots up the pieces of scrap-metal in the direction of iron pipe orientation. The initiation is produced mechanically using booby-trap or remotely (electrically).

Letter bomb

Letter bomb is a type of IED placed in a mail, containing a miniaturized charge of explosive, weighting 2-50 grams. In these charges the explosives sensitive to initiation are used, especially NG, NC, and PETN. NC is used in paper-like form; PETN has a form of 50% paper impregnated with PETN. The initiation system is miniaturized and the trigger system is derived from the opening mechanism of an envelope.

Parcel bomb

The charges placed in the postal packets can have variable designs and are designed to kill or injure the recipient. Its initiation system often derives from the packet opening; however different initiation types are possible.

Large improvised explosive devices

Usually, the large explosive devices weigh from 5 to 1000 kilograms and are exclusively used in terrorist attacks. As a main explosive fill, simple mixtures of ammonium nitrate and oil (or furnace oil), or ammonium nitrate and sugar (or flour) are often used. The ratio of large explosive devices to the overall number of explosive devices is relatively small; nevertheless its social threat is enormous, considering its highly destructive effect and large number of casualties that are caused by explosion. Large explosion devices are therefore used to create an atmosphere of fear and an attitude of insecurity within the society and thus are very effective because its medial publicity is extraordinary.

Improvised explosive device placed on unmanned aircraft

Unmanned aircraft have become a common part of people's lives, they are acquired not only by private companies, but also by quite normal individuals, because the drones are financially more accessible and their acquisition has become an essentially anonymous issue. Authors of this article realize that the use of drones in the form of improvised Explosive device is a specific matter, precisely because of their unexpected possibility of their misuse.

When security forces detect drone near airport area, they may not realize that drone can carry an explosive and attack with its explosive effects an aircraft that, for example, rolls on a runway or takes off. This underestimation may result in a delay in their response and can lead to fatal consequences. Drones are ideal for their application in this case also in that they can develop a relatively high flight speed (over 50 km/h). Large airports are in most cases already equipped with defense systems against drones but not all of them, and the human factor as the only means of protection is totally inadequate.

Conventional, commercially available drones can have a carrying capacity of about 2 kg, more efficient, for example, over 7 kg. The following figure shows the detonation efficiency of 7.5 kg of TNT explosive, as taught by the TerEx computing program.

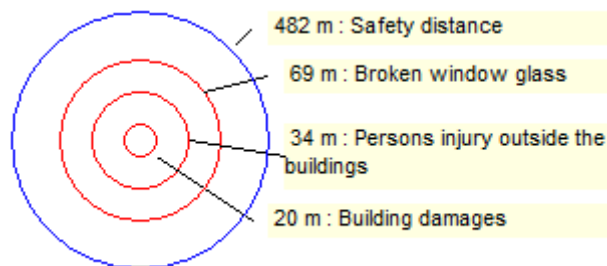


Figure 1 Consequences of explosion of 7.5 kg TNT

IED placement at airports

Above stated IED can be carried to airports together with passengers, personnel or through the supply or service companies. Multilevel security check at airports is carried out in order to locate these systems. Regarding the anonymity the perpetrators can leave the IED unattended in the areas with large numbers of people, particularly in public places of check-in terminals. These IED can be placed into ordinary-looking luggage that was left unattended in the terminals. These objects are so called suspected items.

A suspected item is an object with unknown purpose, location, origin, and owner or where the circumstances of its presence are obscure and its outer design and overall situation on a given place arouse well grounded suspicion that an IED is present. Either a police officer or pyrotechnic on spot decides the abusiveness of the item, following available information and instruction.

The suspected item check is an activity oriented towards IED identification or its components using technical devices or specially trained sniffer dogs.

IED deactivation is an activity leading towards system functional elements intrusion in order to disable the system in a way that any further threat to persons and property will not be possible. This follows when proper check and identification of system components is carried out.

Deactivation can be done by means of:

- Dismounting, when an IED is dismantled to single components without bringing the explosive or explosive substance to explosion itself.
- devitalization i.e. restricting the activity of IED initiation elements
- destruction which is carried out with destruction devices or controlled explosion

Conclusion

IEDs are at present one of the most significant ways of performing criminal or terrorist act in order to achieve various aims. One of the targets of such attack is the field of air transport, while the instrument of terrorist attack is in most cases carried through the airport i.e. its area and facilities. The target destination is usually an aircraft or some airport area that is considered suitable in relationship to the required effects of the attack.

Terrorist use of IED represents higher risk and threat compared to criminal attacks as regards the attacks on airports, because when using explosive devices, main objective is to achieve a maximum damaging effect to persons and property.

Acknowledgement

This paper was elaborated within the framework of the project solved in the Security Investigation Program of MVČR - BV III / 1-VS, under the name "Special charges for increasing the efficiency of interventions of HZS units", under the number VI 20172019081

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