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RISK ANALYSIS OF A GAS STATION

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Abstract
Gas stations have long been perceived as easy targets for petty theft, yet not much has changed regarding safety and security strategies. Each reference object is individual, which also applies to gas stations. However, vandals and attackers are still attracted to these places precisely because of what connects the given objects - how quickly the attacker can arrive at the given object and how quickly he can leave it. Whether by car, truck, or any other means. This fact makes gas stations an attractive and relatively quick target. This article aims to describe the issue of petrol station security and the risks arising from it. To achieve the objectives, the methods of exploration, analysis, and comparison are used. The paper includes an analysis describing incidents that have occurred over the last 3 years.

Keywords: Czech Republic; gas station; safety; security; soft targets.

1. Introduction

This article deals with the general safety of gas stations in the Czech Republic. Gas stations are subject to the specifics of weak security, loose people who do not need to be verified on arrival, and the number of stations varies depending on time, season, allocation, etc. Depending on the attractiveness of the target, these random persons may be physically attacked within the reference vicinity as the number of attackers may increase proportionally with the number of these random persons. From a security point of view, petrol stations can be described as soft targets. In an article by Malatinsky, A. et al. soft targets are defined as an "object, space, or action that is characterized by the presence of a large number of people and, at the same time, the absence or low level of security against attacks". [1] Another article that describes problematic of soft targets should be for example by authors Zema, T. [2] or Hofreiter, L. et. al. [3]

In addition, gas stations are not only a place where people can refuel their vehicles, but many gas stations offer a wide range of goods such as foodstuffs. Thus, people often use these services as a substitute for traditional shops, making gas stations more frequented areas. This trend was particularly observed during the COVID-19 pandemic. The number of visitors to gas stations increased due to the closure of establishments, and restaurants and reduced access to shops and shopping centers. The concept of emergency is also linked to safety and security. These events can be classified into two divisions, namely natural or man-made emergencies. The area of the article is influenced by anthropogenic activity, with a man being the source of all risks, mainly armed robberies, and threats to the lives of service station attendants. [4]

The aim and outcome of the present article are to protect gas stations and their security strategy. It includes the characteristics and location of the selected gas station. Urban gas stations may be located near residential areas that may be inhabited by inadaptable citizens. Service stations on main roads, busy transport links, intersections, etc. near industrial zones, and very busy traffic arteries with high turnover. The area is usually surrounded by gas stations on motorways and

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truck drivers have more traffic. This implies that the security strategy must be approached individually considering the near and far surroundings of the reference object.

2. Safety specifications of gas stations in the Czech Republic

Safety specifications also vary depending on the characteristics and location of the pumping station. However, general safety requirements should apply to all gas stations and their surroundings. These requirements include easy access for arriving vehicles but at the same time difficult access for those in vehicles with illegal intentions.

In this case, perimeter security must maintain the necessary freedom for normal business activities and events around the gas station, but at the same time create a barrier. Examples include the application of concrete blocks or hedges or shrubs. [5]

The installed barrier shall be reinforced with a wire fence to delineate the area where the reference property is not adjacent to a public road. Outside of the Department's obvious pump station from the public right-of-way, consideration shall be given to clear directional signage for open access, unobstructed visibility, and appropriate lighting of the pump station.

According to the Czech technical standard ČSN P CEN/TR 14383, the environment of a service station is divided into the parts mentioned in the diagram below.

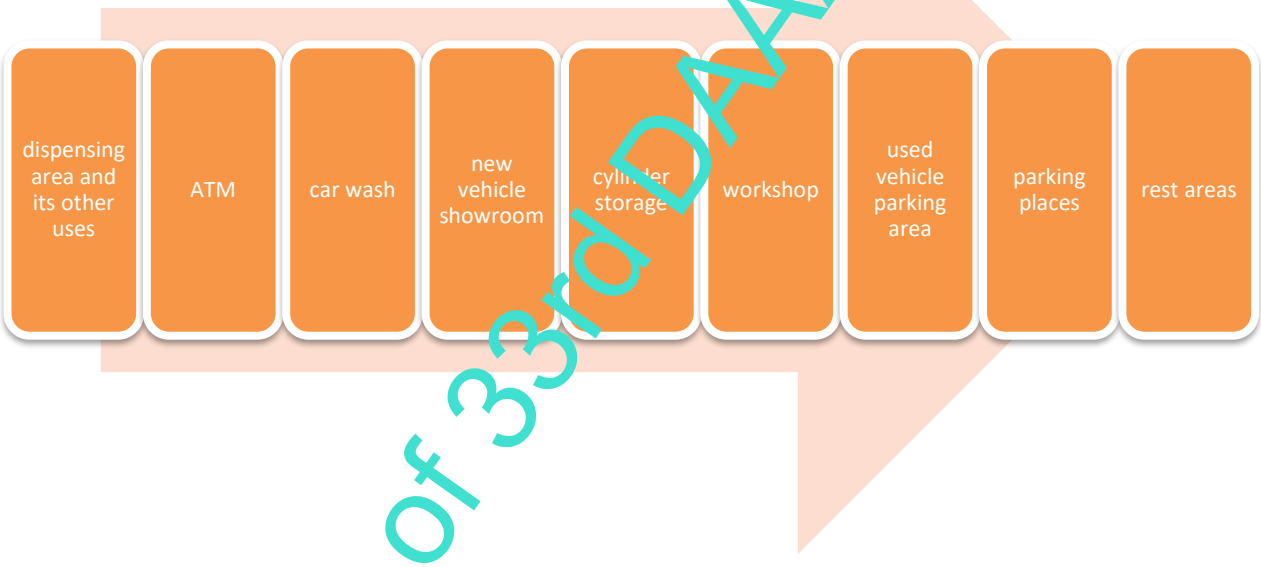

Chart 1. Division of the gas station environment

- **Dispensing area**

The delivery area should be equipped with a device to prevent vehicles from backing out and must always be switched on. However, if necessary, the operator must be able to deactivate it (for example, if the vehicle needs to be released).

Traffic barriers must be installed at the exit. The purpose of these barriers is to make access to the service station more difficult. The dispensing area must be equipped with CCTV, cabling, and optimal cameras. This camera system must be installed to allow surveillance of sensitive areas. Furthermore, their purpose and objective are to detect suspicious behavior and to make potential perpetrators fearful of conviction. However, in the event of an unusual event, these systems need to be unaffected by sunlight and be able to withstand vandalism. Fuel dispensers shall be fully automatic and effectively secured. [5]

- **ATM**

In some European countries, ATMs are installed around gas stations, which, as well as the possibility of buying refreshments, attracts more people. However, their installation also has a negative impact, namely the possibility of an increase in crime. Thus, the presence of this device also increases the risk for gas station attendants.

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The requirements of EN1143-1 should therefore be met. In addition, the location of the ATM should be subjected to a study to include vandalism resistance and resistance to break-ins, particularly through motor vehicle intrusion. [5]

- **Car Wash**

The space of the car wash only increases the risk in the case of coin-operated machines, where there is a risk of theft or vandalism. For this reason, a system working with tokens or special cards, which the customer receives after payment at the service station, is preferred for car washes. A camera system can be installed for possible detection near this area. Often the employees operating the car wash are part of the car wash. [5]

- **Storage of compressed gas cylinders**

An outdoor rack protected by a metal cage should be used for the storage of compressed gas cylinders. The reason for this security is to combine anti-theft security with the necessary ventilation. In addition, this metal cage-protected outdoor rack is also locked with a high-quality locking system complying with EN 12320 or EN1303.

The security itself can be increased by installing a full-width barrier or eye bolts and padlocks. Padlocks and eyelets should conform to the specified EN 12320 standard. [5]

In particular, the conditions it imposes are that the barrier should be strong and at least as strong as the padlock. Padlocks with a concealed shackle should be used. These locks provide the least possibility of being overridden. Fixing bolts and screws with protruding heads should not be able to be loosened from the vulnerable side. They should have coupling-type heads, or the heads should be threaded.

3. Analysis of Threats

The following chapter focuses on and discusses incidents at gas stations in the Czech Republic. Since December 2018, a total of 16 incidents at gas stations have been recorded in the Czech Republic. At this scale, only one incident resulted in the death of a gas station attendant. This was specifically an incident on 3 December 2018. The information on this incident describes the incident as occurring at 3.30 a.m. when two masked offenders entered the premises of the gas station to commit a robbery. During the robbery, a total of CZK 19 000 was stolen from the cash register as several packs of cigarettes. Unfortunately, the gas station attendant was murdered in the process.

Table 1 records all incidents recorded from 2018 to 2022. The table is broken down into several criteria. It lists the date, location of the incident, nature of the incident, the consequence of the act, and the weapon with which the act was committed. [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17]

Date	Location	Incident	Consequence	Weapon
06/01/2022	Písek	Armed robbery	Frightened staff	Gun
07/02/2022	Zlín	Armed robbery	Frightened staff	Knife
15/12/2021	Tišnov	Threats/Robbery	Frightened staff	Lighter
11/09/2021	Babice	Armed robbery	Frightened staff	Pepper spray
25/12/2020	Sokolov	Armed robbery	Frightened staff	Gun
15/12/2020	Praha 5	6x Armed robbery	Frightened staff	Gun
06/08/2020	Brno	Armed robbery	Frightened staff	Knife
07/05/2020	Ostrava-Poruba	Armed robbery	Frightened staff	Gun
20/03/2020	Rozhovice	Armed robbery	Frightened staff	Knife

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Date	Location	Incident	Consequence	Weapon
05/12/2019	Vyškov	Armed robbery	Frightened staff	Gun
23/10/2019	Plasy	Armed robbery	Frightened staff	Gun
10/10/2019	Praha	Armed robbery	Frightened staff	Gun
02/08/2019	Lovosice	Armed robbery	Frightened staff	Gun
16/12/2018	Rozhovice u Heřmanova	Armed robbery	Frightened staff	Gun
12/12/2018	Rumburk	Armed robbery	Thud attendant	Metal Stick
03/12/2018	Nelahozeves	Armed robbery	Death of an attendant	Gun

Table 1. List of incidents in the Czech Republic

4. Technical Security Solutions

The specific security requirements of individual filling stations may vary depending on their location and wider surroundings. The proposal for specifying technical security is based on a table of attacks on gas stations in recent years.

To specifically determine the appropriate technical security for a particular reference site, a risk analysis would need to be developed, with values reflecting the specifics of the gas station and its surroundings. The list of incidents shows that armed robbery resulting in intimidation and psychological harm to staff is the most significant. The information provided indicates a situation where an attacker may get close to the staff, bring a weapon into the premises of the service station, and use this weapon to threaten the service station staff. Figure 1 illustrates the use of event-tree analysis.

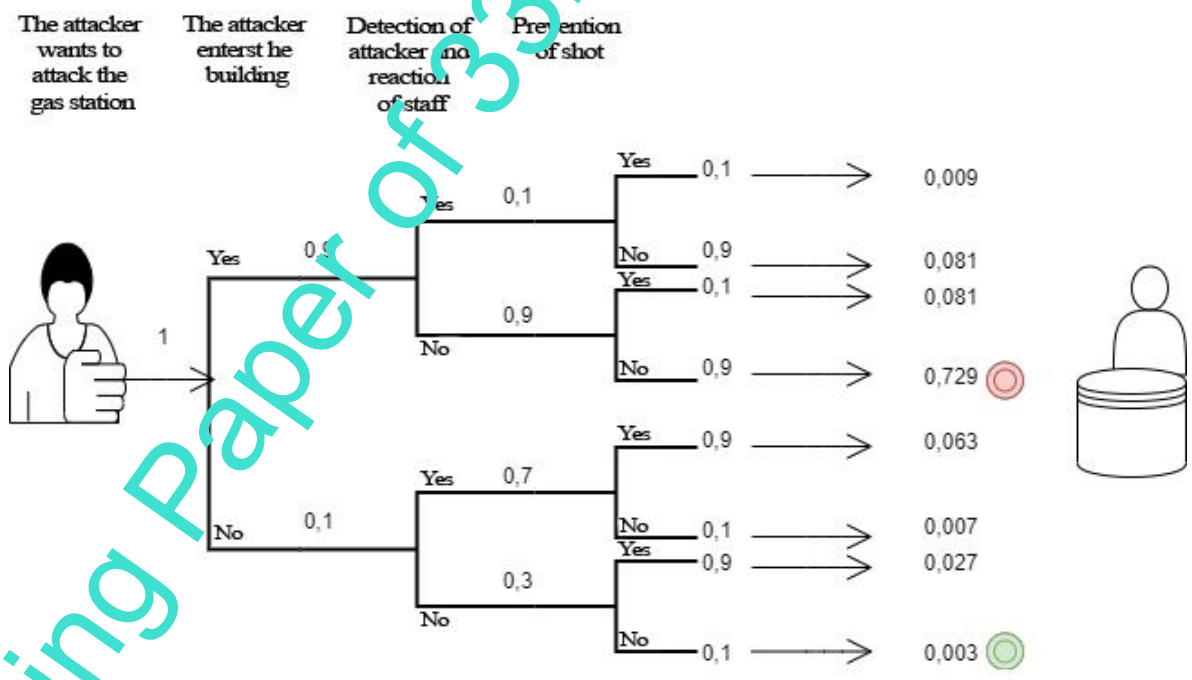

Fig. 1. Event-Tree Analysis

The diagram in Figure 1 shows the steps of the event tree analysis. The most likely scenario is the one shown in the diagram below.

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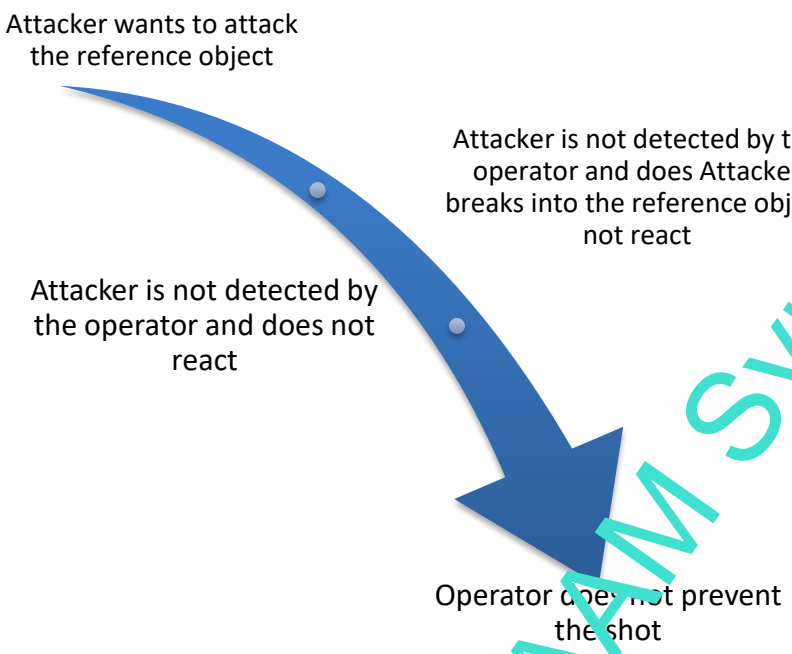

Chart 2. The most likely scenario

This scenario is not only the most likely under the current state of gas stations but can also result in death.

It can also be seen from the diagram that the largest differences in values is in the first step of the "Attacker enters the facility" scenario. This step should be given special attention if it is nighttime or if the number of gas station personnel who could intervene in a critical situation is compromised.

Fig. 2. Dispensing window at the gas station in Portugal [7]

To ensure the highly probable "Attacker enters the building" step, which is particularly dangerous during night shifts, complete barring of all persons from entering the interior is suggested. The use of Sterling products' "Night-Pay Window" made of bulletproof glass with a special stainless-steel box built in for the exchange and transfer of people's belongings

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on both sides not only maximizes security but also makes the job of disinfecting viruses and bacteria (for example, during the COVID-19 pandemic) easier. For this reason, it appears to be one of the best options applicable to gas stations. [18]

Fig. 3. Night-Pay Window with audio transmission [18]

After the introduction of bullet-proof glass with a special box for dispensing and receiving goods, there could be a problem with customer turnover at a given gas station. The slowdown in service could also cause a clustering of people waiting to pay for fuel.

As part of this issue, it is proposed to extend the QR code payment option using a smartphone to all gas stations. Currently, only the Benzina gas station chain has this option. This method of payment would significantly reduce the number of customers requiring any interaction with the service station attendant and would reduce the number of people waiting at the bulletproof glass dispensing window. [18], [19]

5. Conclusion

Gas stations have been a focus for potential vandalism in the past. In theory, it could be argued that if an attacker is prepared to attack completely unprepared, often gas station staff with long opening hours, they are an easy target. The attacker can quickly get to the gas station and escape on foot or in a motor vehicle after committing the crime.

According to the table of attacks, 16 attacks have been committed against gas station operators in the last 3.5 years. These conditions are so impossible to monitor that relying on human factors and operator training to defend oneself in a crisis is not enough. Much more emphasis needs to be placed on prevention, technical security, and, if possible, maximum elimination of the threat, which will be helped by the security measures proposed above.

In the securitization of gas stations in the Czech Republic, the standard for technical safety elements should be increased. Since threats, security risks, and scenarios are similar in every EU country, their form should be standardized.

Starting to see technical security solutions as a form of breaking the attack scenario is a start. In future work, we would like to focus on the possibilities of standardization and forms of security measures from the point of view of psychology. Mentally scaring the attacker is often enough to ward off an attack. This form could be considered as part of a practical benefit/cost comparison.

The methods of explanation, analysis, and comparison were used to reach the objectives of the article. Attacks on gas stations in the last three years in the Czech Republic were analyzed and both the methods of attacks and their impact on the operators were described.

This article provides a perspective on the security of petrol stations and all the people around them. There is a need to address this issue and to protect smaller objects, which may be petrol stations. Security itself is an ever-growing and dynamic trend that is spilling over into all areas. Future research aims to further describe and specify the means of protecting petrol stations and protecting them from attack.

5. Acknowledgments

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