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Loss Prevention in Times of Blackout

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Electricity has become an indispensable part of life, which belongs to today's modern household. On the contrary, there is an increasing dependence on sources of electricity. It is used in all sectors of human life, including the sector of health care. Today, healthcare is dependent on sources of electricity. Therefore, several clients are dependent on electricity availability in healthcare facilities; however, there are situations as a blackout. It could be caused by several events, such as disasters that could cause cascading effects. This impact is significant for healthcare facilities. Healthcare facilities must ensure that the supply to critical electrical circuits is not interrupted. In the event of a blackout, alternative sources of electricity are used immediately. One of them may be aggregates that could replace the electricity supply. However, these resources depend on fuel supplies. Most healthcare facilities do not have sufficient fuel supplies to supply healthcare facilities during a blackout. Healthcare facilities' attitude is to use the purchase of fuel for aggregates at the nearest fuel stations. But here comes the critical question. Will the fuel stations be operational even in the event of a locally more massive blackout? Where do we get the fuel? Will the state provide us with funds from the Administration of State Material Reserves (ASMR)? We will get the answer to these questions in this paper. The aim of the paper will be to solve loss prevention in times of blackout. The paper will be divided into several parts. Firstly, there will be evaluated of the current situation. Secondly, there will be a proposal for loss prevention in blackout times - an algorithm for solving healthcare facilities' fuel supplies.

1. Introduction

Electricity has become an indispensable part of life, which belongs to today's modern world. Electricity is part of the energy sector. To the energy sector belongs electricity, heat, gas, and oil. Energy forms the necessary infrastructure of the state. Rehak et al. (2018) state that society is dependent on a whole range of infrastructures. European Council (2008) states that some of them began to be designated as Critical over time. Critical infrastructure elements are regularly exposed to the harmful effects of naturogenic and anthropogenic threats. (Kampova et al., 2020) The resilience in critical infrastructure elements can currently be evaluated using several various methods, e.g., CIERA. (Splichalova et al., 2020a) Globally, the frequency of natural disasters has increased significantly in recent decades (Munasinghe and Matsui, 2019) and have been more devastating and significantly impacted societies' health and lives. (Goniewicz and Goniewicz, 2020) The interdependence or effect on secondary sectors is relatively high. (Splichalova et al., 2020b)
One of the elements of the critical infrastructure is the healthcare area too. (Rehak et al., 2020a) Resilience in energy services has always been a top priority, especially for high-value facilities like hospitals. (Anderson et al., 2018) While providing essential and demanding health care to society´s most vulnerable populations, healthcare facilities also belong to the most demanding category of risk a life if and when a disaster occurs within its walls. (Goniewicz et al., 2020) A guarantee of energy supply is required to ensure continuity of medical procedures. (Suszanowicz and Ratuszny, 2019) Blackout depends on many factors. These factors can lead to a more or less critical blackout. One of the factors is played by so-called cascade effects. (Rehak, 2020b). Healthcare facilities are one where a blackout would endanger hundreds to thousands of lives. Therefore, healthcare facilities must be prepared for a blackout. The aim of the paper will be to solve loss prevention in times of blackout. The paper will be divided into several parts. Firstly, there will be evaluated of the current situation. Secondly, there will be a proposal for loss prevention in blackout times - an algorithm for solving healthcare facilities' fuel supplies.

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2. Analysis of Current State in the Healthcare Facilities in the Czech Republic

It is essential to have a robust electricity replacement system to ensure the proper operation of healthcare facilities. Replacement power supplies are UPS (Uninterruptible Power Supply) and aggregates. A UPS is a device or system that provides a continuous supply of electricity. It is used for equipment where it is necessary to ensure uninterrupted power supply in a primary power supply failure, e.g., healthcare facilities. UPSs provide power recovery in milliseconds. Their maximum operating time is 3 hours.
On the other hand, there are used aggregates too. Aggregates need time to restore the electricity supply. It is a recovery in seconds to minutes. The aggregates could run on petrol or diesel. However, healthcare facilities do not have the required amount of oil. It is, therefore, necessary to use a combination of UPS and units. There is the arises problem of the healthcare facilities. An analysis was performed at healthcare facilities in the Czech Republic. This analysis was divided according to the priority of the object. (Hromada, 2019)

Table 1: Object priority (Hromada, 2019)

Priority 1	Priority 2	Priority 3
Faculty hospitals	Healthcare facilities such as polyclinics	Preventive care
Regional hospitals	Hospitals for long term sickness	Rehabilitation care
City hospitals	Specialised centres providing health services	
Rehabilitation hospitals		
Hospitals with a polyclinic		
Psychiatric hospitals		

The readiness of healthcare facilities that could solve a blackout according to a predetermined scenario was analyzed. This scenario envisages a blackout of 8 hours and a power recovery time of 32 hours. Overall, according to the set scenario, it can be assumed that healthcare facilities will be without electricity supply for 40 hours.
Out of the total number of 20 verified healthcare facilities, only three healthcare facilities are ready to blackout in a total time of 40 hours. These three healthcare facilities have sufficient fuel supplies. The remaining 17 healthcare facilities are not prepared for a blackout.
This technical report presents the average amount of missing fuel aggregates according to the healthcare facility's priority. The healthcare facilities included in priority 1 have lack an average of 2477 liters of fuel. Healthcare facilities classified in priority 2 lack have an average of 6810 liters, and priority 3 lacks 750 liters of fuel.
Should healthcare facilities obtain fuel for aggregates? For this purpose, procedures for obtaining fuel for healthcare facilities have been proposed.

3. Results

Based on the proposed assessment system were evaluated healthcare facilities in the Czech Republic. A total of 20 healthcare facilities were assessed, where the results were further divided according to individual types of healthcare facilities and according to the healthcare facility's priority. A total 85 percent of healthcare facilities are not prepared for the blackout, which is considered an enormous amount. According to the evaluation of the capacity of aggregates in critical circuits, all healthcare facilities were prepared. Proper design of aggregates for healthcare facilities represents an essential role in the possibility of covering critical circuits of these facilities and their subsequent readiness in the event of a blackout.
Furthermore, the assessment focused on readiness in terms of fuel stocks for aggregates. Based on the set scenario, the healthcare facility must cover the blackout, including the recovery time of 40 hours. Only three healthcare facilities reach this criterion. These are urban and regional hospitals that fall into priority 1. The remaining 17 healthcare facilities do not have sufficient fuel supplies. The missing amount of fuel varies, from 12,000 liters to 40 liters. It is considered a significant shortcoming that healthcare facilities do not have enough fuel stocks for the specified blackout scenario. Firstly, there will be a presented bow tie diagram with the concern to blackout.

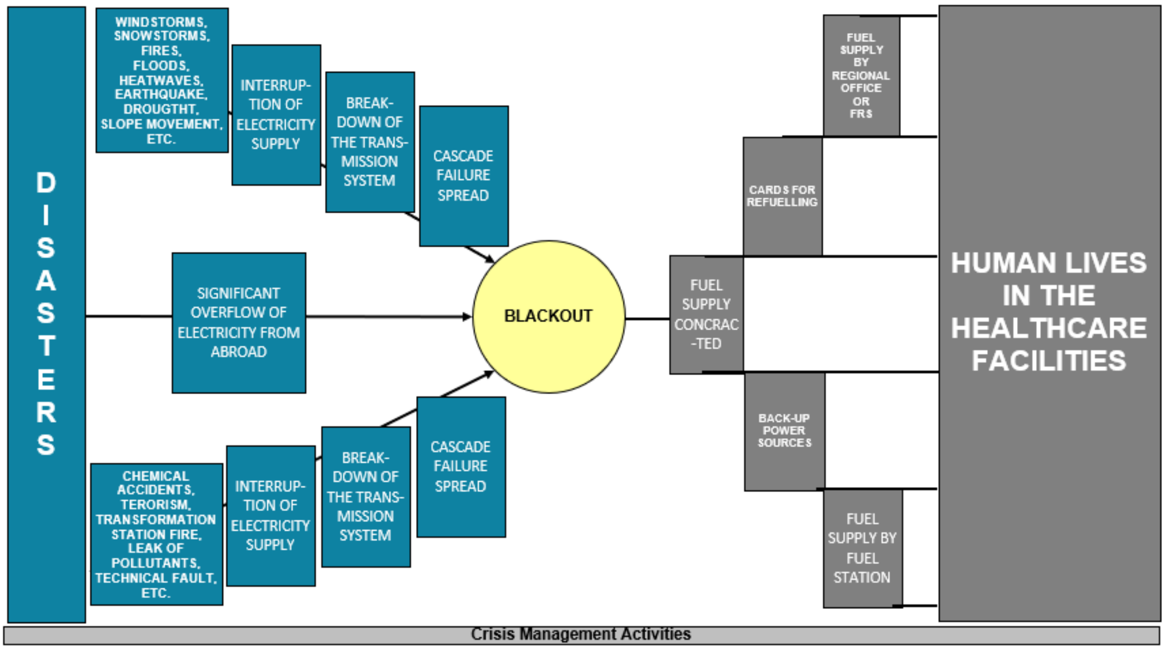

Figure 1: Preparatory part at rest

Based on the findings, measures have been proposed to maintain themselves in the event of insufficient fuel. The proposed measures were divided into two parts. The first part deals with the preparatory part at rest. It is a proposal for efforts to prepare for the situation and ensure sufficient fuel supplies. This part should be solved in the department for special tasks (regional office).

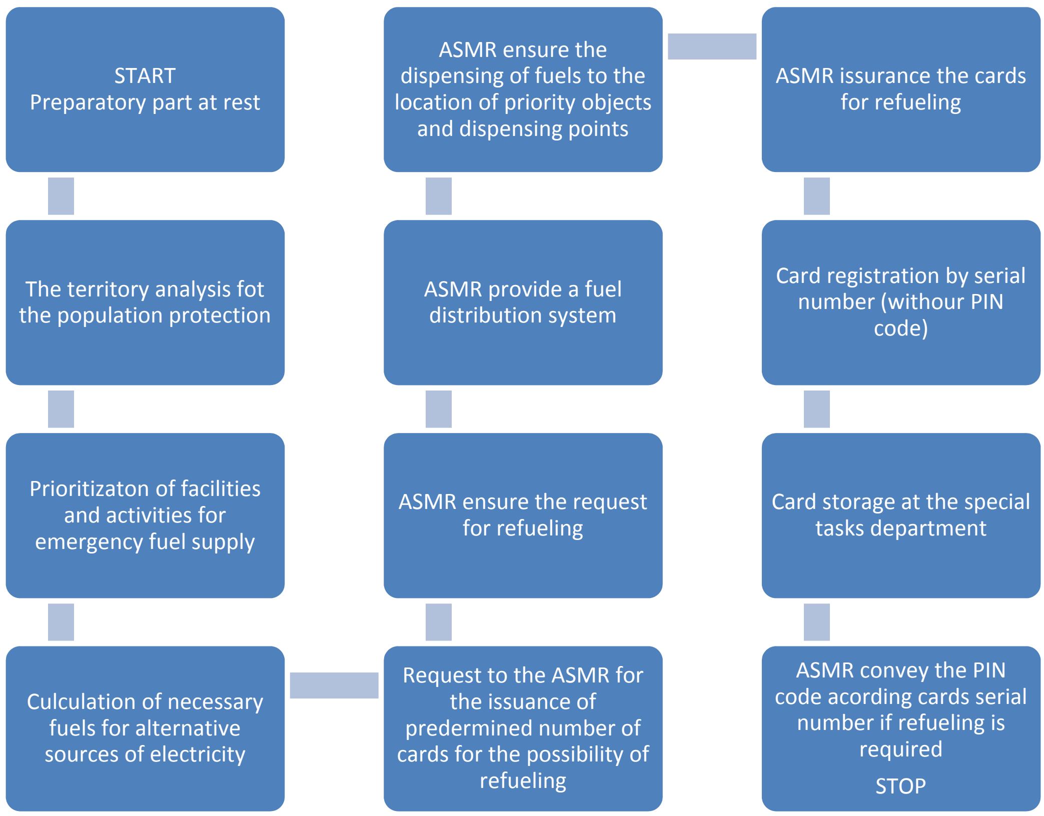

Figure 2: Preparatory part at rest

The second part of the measure deals with the situation when there is already a blackout - the disintegration of the transmission system and healthcare facilities lack fuel supplies.

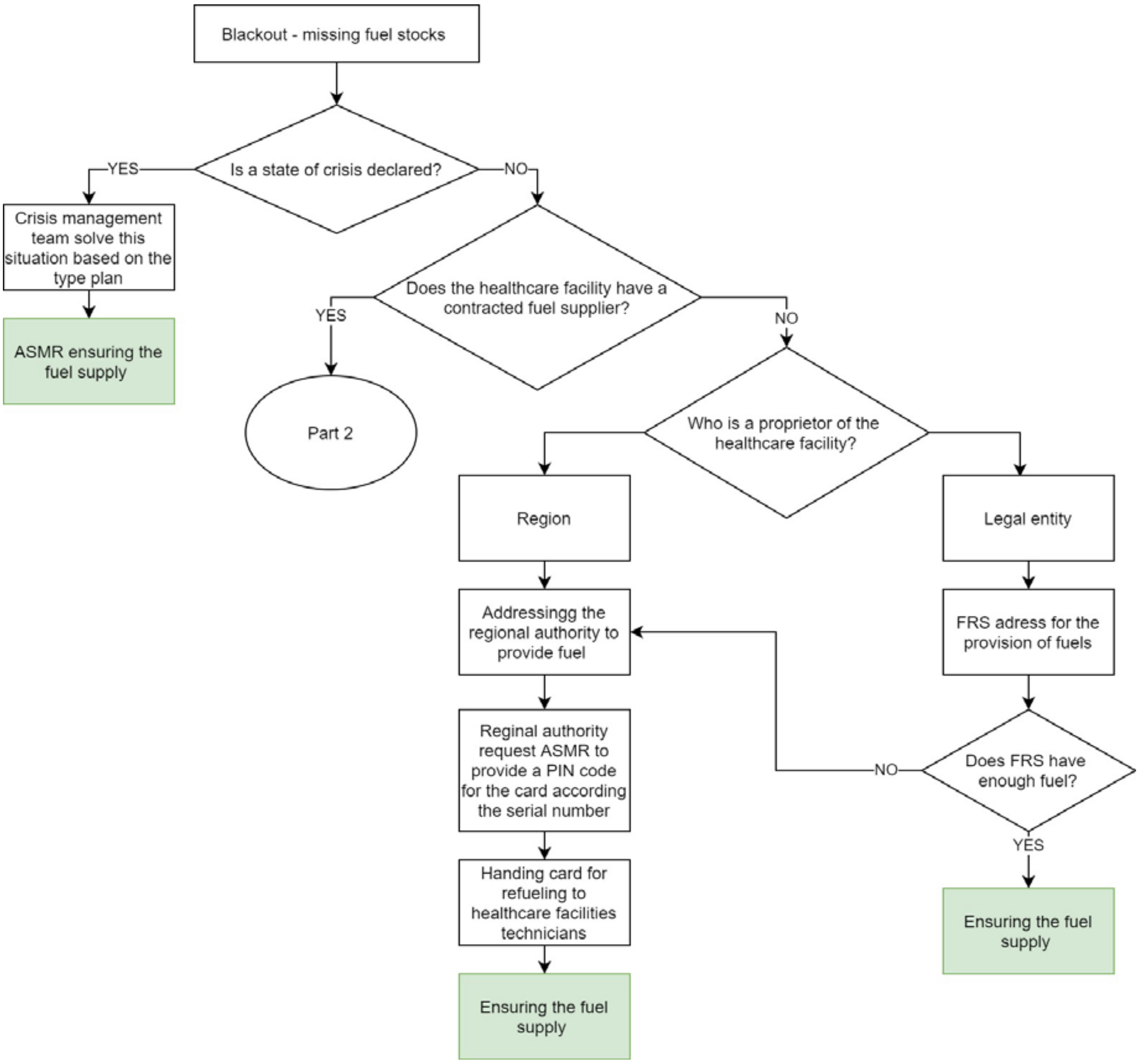

Figure 3: Missing fuel stocks – algorithm for ensuring

Figure 3 shows the algorithm for ensuring the supply of fuel for the healthcare facilities. As can be seen, the crisis managers of the healthcare facilities must solve several problems places. In the first part, they must take the information about the state of crisis. Is a state of crisis declared? If not, they must solve the area of the contract fuel supplier. Based on this information, they could continue by this algorithm or second part (Figure 4). If the healthcare facilities have a contract fuel supplier, they must know the healthcare facilities' founder. Firstly, it could be a region. If it is a region, we continue to follow up on the preparatory part and have the opportunity to obtain fuel from the ASMR. Secondly, it could be a legal entity. In this case, the healthcare facilities must ensure the fuel stock by the Fire Rescue Service (FRS).
If the healthcare facilities have no contract fuel supplier (previous column), they must continue with Figure 4. As can be seen, the healthcare facilities' crisis managers must solve several problems places again. There must crisis managers and the contractors of fuel supply solve other decisions. One of them is the problem with the electricity in the building of the fuel station. Fuel stations could not release fuel supply if in the building is not electricity. If not, they must solve the other problem with the backup power source and the connection point for a backup power supply. Based on this algorithm, the healthcare facilities could take the fuel supply for the aggregates.

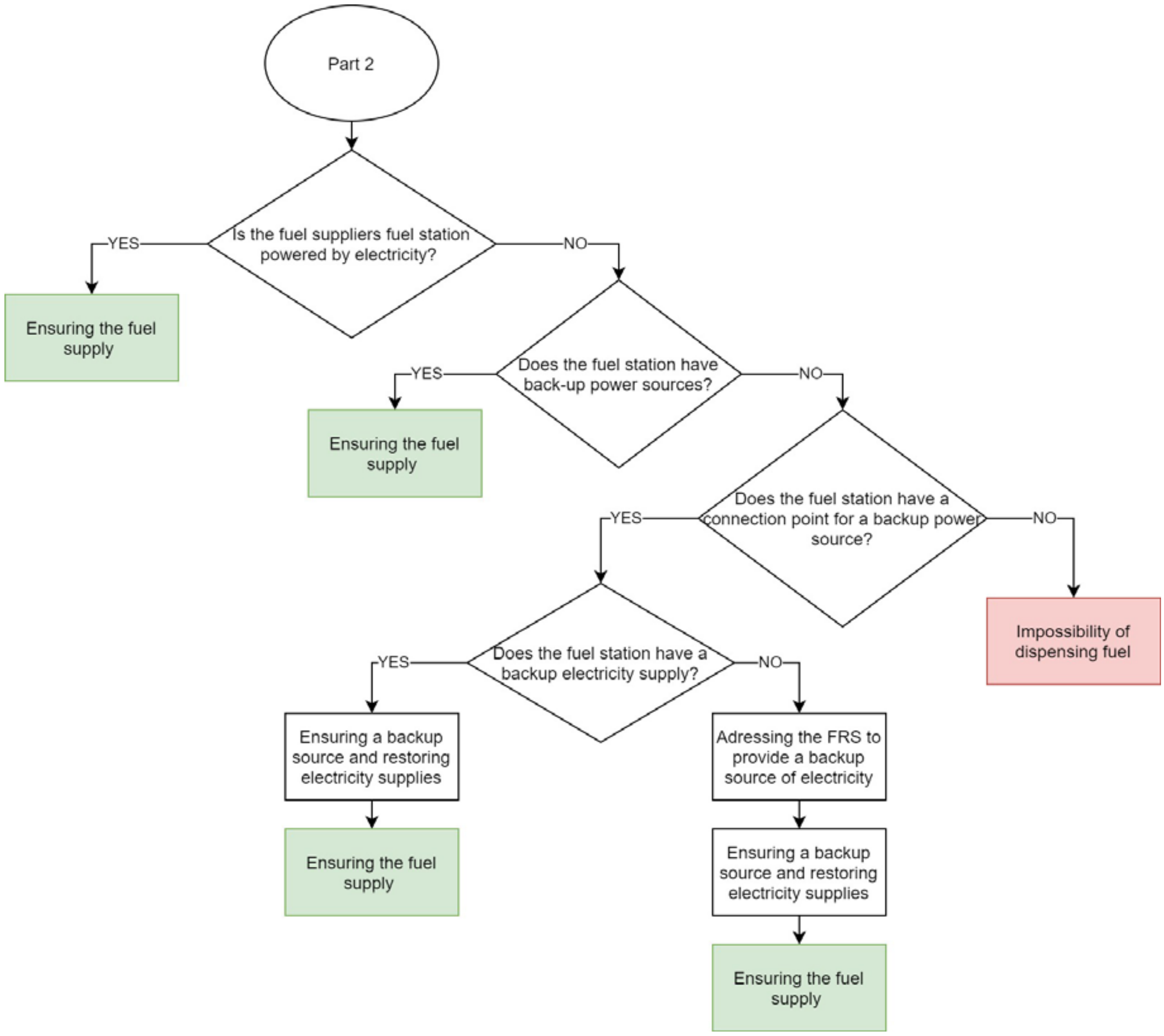

Figure 4: Missing fuel stocks – algorithm for ensuring

Figure 4 shows the second part of the algorithm for the missing fuel stocks. This system of obtaining fuel sources into alternative sources of electricity represents a unique way to save clients' lives and health in healthcare facilities in the event of a power failure.

4. Conclusion

The aim of the paper was to solve loss prevention in times of blackout. The paper was divided into several parts. Firstly, there was evaluated of the current situation. Secondly, there was a proposal for loss prevention in blackout times - an algorithm for solving healthcare facilities' fuel supplies. Based on the analysis, we took the data about the preparedness of the healthcare facilities in the Czech Republic. Based on these data, we found out that 85 percent of healthcare facilities are not prepared for the blackout. For this high number of unpreparedness was proposed, the algorithms to ensure fuel stock. These algorithms will be presented for the Administrative State Material Reserves. At the conclusion of the paper, we would like to compare the other research paper and the assessment of the healthcare facilities abroad. Brehovska et al. (2017) add information from the Czech Republic too that there is no preparedness for extensive and widespread outages of the healthcare facilities. Next, Heite et al. (2011) inform about the situation in Germany. Whereas hospitals are in general well prepared concerning shorter outages, due to obligatory emergency power in Germany, outpatient medical care, nursing homes, and, in particular, home-care nursing is affected early. Failure of these sub-sectors puts additional strains on hospitals. If outages last more than one day and are associated with the failure of other critical infrastructures, especially water supply, hospitals may be severely affected. Nakayama et al.'s (2014) research also address the need to provide power in the event of an outage of more than 24 hours. He also adds that the pressure to stay in a bold facility will increase due to the arrival of electricity-dependent patients in home-care.

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