

Population protection with emphasis on environment safety

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Abstract— The third call of the Ministry of Interior of the Czech Republic concerning the support of research, experimental development and innovation, was announced for the period 2013 – 2015. The Department of Radiology, Toxicology and Population Protection, Faculty of Health and Social Studies, submitted an application for research concentrated on population protection according to population differentiation. The aim of the project is to analyze the current status of the evacuation planning from the emergency planning zone according to the population differentiation and the population's readiness for potential disruption of functionality of critical infrastructure, to suggest new methods of evacuation planning incorporating new aspects of health protection during evacuation and to design manuals for the population on how to handle emergencies with a disruption of critical infrastructure as well as ethical issues arising in this context. One of the basic tools of population protection against the negative effects of emergency situation is evacuation planning. It is a set of selected information prepared and procedures. All persons come under evacuation except works who take part in the rescue operation and person who control the evacuation. Social institutions are specific service for citizens providing social services to socially disadvantaged people. These institutions take to themselves responsibility for the care of these people. The social care must be provided in depending on the type of service at all times. It cannot be unreasonably cancel or interrupt. In case of an accident at a nuclear installation is required to each device was adequately prepared.

Keywords— Evacuation – Environment – Radiation – Population Differentiation – Planning – Health

I. INTRODUCTION

Environmental safety has in recent years gained in importance. All human activity brings a number of risks that affect the quality of human life and health. The risks which endanger environmental safety are caused by

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anthropogenic and natural factors or a combination of both. Among the main threats which cause emergency situations and environmental threats are the floods, drought, prolonged inversion situation, etc. (as natural factors, and major accidents, terrorism, critical infrastructure disruptions (as anthropogenic factors).

In emergency management, environmental security is a condition in which the occurrence of a crisis situation will lead to no more than an acceptable disruption of the environment. [1]

Natural disasters occur beyond human control. In many cases it is possible to affect their progress by long-term systematic preparation and planning, or their mitigation. Anthropogenic disasters are threats caused by environmental contamination toxic or radioactive materials. The environmental contamination could be by production or manipulation, i.e. by various types of technological and human failures in enterprises, with consequences for human health and property. [1]

The issue of environmental safety is a subject matter for the EU, where the EU materials on disaster prevention generally formulate further directions to protect the population and the environment and call on Member States to take measures to mitigate the effects of anthropogenic and natural disasters. [2]

Strategic planning documents for the Czech Republic are the following in particular: the Strategic Framework for Sustainable Development of the Czech Republic, the State Environmental Policy of the Czech Republic, the Czech Republic Security Strategy, and the Concept for Environmental Security.

The Concept of Environmental Security aims to propose measures which limit the possible occurrence of emergency situations which endanger environmental safety and environmental health.

Demands for a safe handling of radioactive substances are gradually increasing with the development in that area, especially with use of nuclear energy where the main objective is supervision over nuclear safety.

Accidents in nuclear facilities present a great danger. This accident may involve the release of radioactive substances into the environment which causes concerns for environmental health. Leakage of radioactive substances may be so large that it necessitates the evacuation of a large urban area. Its range can be hundreds of kilometers. [1, 3]

II. SECURITY RESEARCH PROGRAM

To reduce threats in the Czech Republic, the Ministry of Interior proclaimed the Security Research Program in the Czech Republic in the years 2010 - 2015, where into the 3rd public tender in research, experimental development and innovation project of the University of South Bohemia in České Budějovice was accepted, titled "Population Protection According to Population Differentiation", which is designed for 2013 - 2015.

The aim of the project is:

1. analysis of the current status of evacuation planning from the emergency planning zones of nuclear power plants Temelín and Dukovany, according to the differentiation of the population, and to prepare people for possible disruption in critical infrastructure
2. proposing a new methodology for evacuation planning along with integrating new aspects of medical support
3. designing manuals for the population for the procedure to handle emergencies with the disruption of critical infrastructure in the context of ethical issues.

Evacuation of people has to be dealt with in the field of fire protection as well as crisis management. Evacuation is addressed in Law no. 239/2000 Coll., about the Integrated Rescue System and some amendments [4] (§ 7, paragraph 7, letter f, Section 10, paragraph 5, letter f, Section 15, para. 2, letter c, §16, letter b, Section 24, paragraph 1, letter b) and by regulation no. 380/2002 Coll. of the Ministry of Interior, about the preparation and execution of tasks of Population Protection [5] (Part Four, §§ 12- 14). Specific actions in this area are in accordance with the regulation no. 328/2001 Coll., of the Ministry of Interior on some details of the Integrated Rescue System [6]. It is included in the Plans for specific activities which form part of the emergency plan of the region and the external emergency plan. These plans are: the Evacuation plan as part of the Emergency plans of the region and Plan for evacuation of people (external emergency plan). Regulation no. 246/2001 Coll., on the determination of fire safety conditions and state fire supervision in § 33 of the Fire Evacuation Plan governs the procedure for evacuating people, animals and material objects affected or threatened by fire. [7]

Evacuation is considered as the most effective and widely measure, which is done to protect during population protection against the possible consequences of threatening or resulting emergencies. This measure applies to the entire population in areas at risk of extraordinary events except persons who will participate in rescue operations, the management of evacuation or people how will engage in any emergency action. In the first step is evacuation planed in give preference to selected population groups. [8]

Evacuation means ensuring displacement people, animals, objects of cultural value, technical equipment or machinery and materials necessary for the preservation production and hazardous substances from the places threatened by an extraordinary event. Evacuation is carried to places that

provide for evacuees alternative accommodation and meals for animal housing and storage for things (Decree no. 380/2002) [5]

In the areas of emergency planning of nuclear installations (Dukovany Nuclear Power Plant, Temelín Nuclear Power Plant), the planned evacuation relates to the population of a part or the whole of the urban area, or a larger territorial area. [9] It is based on the following principles:

- a) in case of a fault in a nuclear power plant technological mechanism, which could result in a radiation accident, the preparation of direct evacuation is initiated. Direct evacuation means evacuation carried out without previous sheltering of the evacuees.

in the case of a radiation accident, depending on the wind direction, evacuation with sheltering is carried out from the centre and from other selected sectors. Evacuation with sheltering means evacuation conducted prior sheltering the evacuees and after reduction of the initial risk of exposure to radioactive cloud

2.1. Security research program

To determine the underlying data to process a certified methodology that will serve as the basis for the adjustment of legal measures related to the EPZ nuclear facilities, there is a questionnaire survey.

To cover all spheres of life in the emergency planning zone (hereinafter "EPZ"), four types of questionnaires have been prepared for households, individually for physical persons, schools and educational facilities and social facilities. [10]

2.1.1. Household questionnaires

Between November and December 2013, questionnaires were distributed to all local authorities in both EPZ's. The questionnaires are addressed to all households in both EPZ's. Distributed questionnaires are registered in the municipalities in the way that 13,750 questionnaires were distributed in the EPZ TNPP and 40,740 questionnaires in the EPZ DNPP, making a total of 54,490 questionnaires.

In parallel with this paper form an electronic version of the questionnaire was prepared with the possibility of completing it directly on-line on the faculty website. This is a questionnaire for households in the EPZ's. The evaluation of the questionnaires has not yet been completed, but the EPZ of Temelín nuclear power plant returned 904 questionnaires and the EPZ of Dukovany nuclear power plant has returned 4,349 questionnaires.

2.1.2. Questionnaires for physical persons

In the same period, April to November 2013, a questionnaire was prepared for physical persons. Because this

survey aims to determine accurately the views and knowledge of the population by age groups, citizens were divided into 4 age groups.

To ensure the objectivity of the investigation and the statistical significance of the investigation, it was all based on the percentage representation of each of these groups of the population determined by the last census; in the same proportion the number of questionnaires was prepared for individual communities of both EPZ's. The questionnaires were addressed to all municipalities of both EPZ's and the survey was conducted by contact mode.

Every EPZ was addressed 500 questionnaires. Considering the mode of data assembling, 100% of questionnaires were returned.

2.1.3. Questionnaire for nurseries, primary and secondary schools and educational facilities

All nursery, primary and secondary schools and educational facilities were found in each EPZ. The questionnaire is focused on personal and material possibilities of each school. In the EPZ of Temelín nuclear plant there are 11 kindergartens, 12 primary and two secondary schools. There is also one educational facility. In the EPZ of Dukovany nuclear power plant there are about 70 kindergartens, 66 primary and 5 secondary schools and three educational facilities. In all schools, data for the questionnaires, a total of 16 questions, were obtained by contact mode with the exception of schools in the EPZ of Dukovany, where questionnaires were sent to each school with a covering letter asking for their completion.

2.1.4. Questionnaire for social facilities

The same procedure was followed with social facilities, data collection by contact mode in all facilities, which means that in the EPZ of Temelín nuclear power plant there are 2 social facilities and both questionnaires are available, and in the EPZ of Dukovany nuclear power plant there are 12 social facilities. Also, all completed questionnaires are available. The questionnaire contains 20 questions.

III. RESULTS AND DISCUSSION

3.1. Household questionnaires

This was historically the largest survey in the field of population protection in the emergency planning zones (hereinafter "EPZ") around both nuclear power plants (Temelín, Dukovany). This survey included all households in the areas of emergency planning.

After evaluating various questions in the questionnaire we obtained the following results:

Depending on the number of household members who

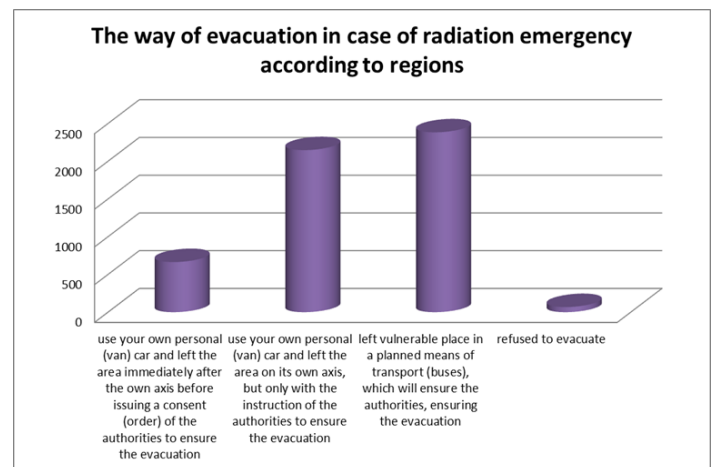
commute to work or to school outside the EPZ it could be determined how many people on average remain in the EPZ during working hours. The survey shows that overall 42% of the population commute to work or to school outside the EPZ.

Another question assessed the general knowledge about peoples' behaviour upon hearing the siren signal called "General warning". The right behaviour would have been shown by 78% of the families, ie. they would have sought shelter in a brick building and watched some mass media. The worst possible version of people's behaviour was noticed in 11 % of families. It means to leave the House and find out what was happening.

One of the main issues was how to evacuate families from the EPZ in the event of a radiological emergency. Over 13% of respondents' families would leave the EPZ by using their own personal car before the institutions responsible for evacuation would have even announced the need for it. The right approach which means leaving the EPZ on their own, but with the knowledge or instruction from authorities who are responsible for evacuation would have been chosen by 41% of the families. From the above numbers it follows that 45 % of families the in EPZ would have to be evacuated by vehicles provided by the authorities who are responsible for the evacuation. It is alarming that 1 % of families would refuse to evacuate altogether.

In this context, the percentage of household members who commute to school or work outside the EPZ is not negligible from a safety perspective, and thus we can assume that there was always a certain percentage of the population outside the EPZ.

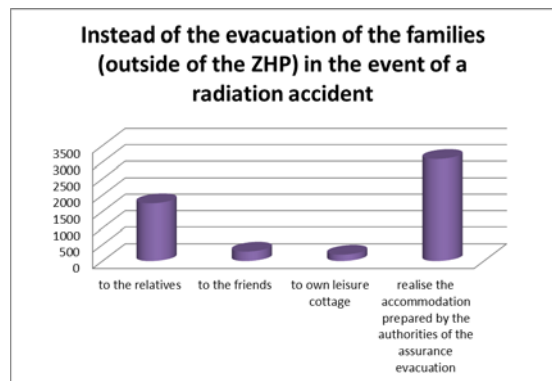
Figure 1 The way of evacuation in case of radiation emergency according to regions



Another important component of our research was monitoring where families would go and what kind of accommodation they would use. 42 % of the evacuated families would seek accommodation with their relatives or friends or on their own holiday cottage / chalet outside the EPZ. It follows that in the case of an evacuation authorities

would have to prepare accommodation for 58 % of families evacuated from the EPZ. The authorities can accurately plan evacuation if the average number of family members is known.

Figure 2 Instead of the evacuation of the families (outside of the ZHP) in the event of a radiation accident

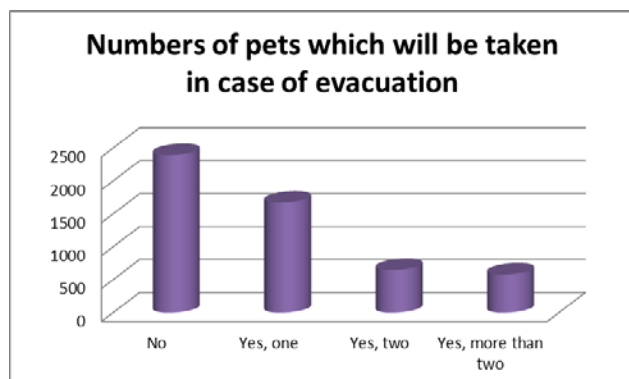


In the questionnaire there were others questions dealing with health aspects of individual family members. One question asked for the percentage of families where one of the members is disabled. Respondents reported that 16 % of the families have at least one disabled member. There are 3 % of families where more than two members are affected. The answers to the next question shows that the highest number of disabled members are physically handicapped, followed by hearing and visual impairment with approximately the same proportions.

To help people with disabilities it was suggested that people could register in the system that takes into consideration special needs in case of evacuation. It is striking that 81% of the families answered "no" or "rather no". Other 8 % of families answered "rather yes".

A final last question aimed at animals in families living in the EPZ. Evacuation and decontamination of animals will be a problem in itself. There are 23 % of families that would take with them 2 or more animals.

Figure 3. Numbers of pets which will be taken in case of evacuation



This fact will make difficulties in case of the carriage of persons, their decontamination and in the spare/emergency accommodation. On this fact the authorities must ensuring the evacuation to respond as follows:

a) in the carriage of pets use the means of reducing the danger of animals for the surroundings (such as muzzles, leashes, a crate, a portable aviary). The ferocious, poisonous and otherwise dangerous animals excluded from the carriage,

b) during the decontamination use specific methods of decontamination appropriate for the individual animal species. In emphases with the dry decontamination which is safe for most animals and is not too time consuming. The ferocious, poisonous and otherwise dangerous animals excluded from the decontamination,

c) during emergency accommodation to use in animals the means of reducing their risk for the surroundings. The ferocious, poisonous and otherwise dangerous animals excluded from the possibility of their harbouring in the accommodation. This action is necessary to popularize and emphasized in the context of preventive and educational activities.

3.2 Questionnaire for nurseries, primary and secondary schools and educational facilities

Schools and school facilities have their own obligations in the field of security and protection of life and health, which arise from a variety of legislation. One of the tasks for schools is the preparation of documentation. This documentation is not different for individual schools and school facilities with the exception of classification according to the degree of fire risk according to Law no. 133/1985 Coll. on Fire Protection. [11]

All schools are classified to the category of "no increased fire risk" with the exception of facilities designed on the basis of a special permit for persons with reduced mobility, as well as in educational establishments of seven or more floors or four or more floors if these objects have established a protected escape route (this follows from Section 4 paragraph 2 letter h), of the Fire Protection Act) [11]. Persons with limited mobility means physically disabled persons (especially person on wheelchair), visually and hearing impaired, elderly, pregnant women, persons accompanying a child in a stroller and children under three years of age, or a person with a mental disability.

The Fire Evacuation Plan shall be prepared for objects and spaces which are in difficult conditions for intervention or where activities with high fire risk are carried out and, where stipulated by the fire protection documentation based on an assessment of fire safety conditions, also for other activities. The Fire Evacuation Plan regulates the procedure for evacuating people, animals and material objects affected or threatened by fire.

On the question whether their school had worked out an evacuation plan (procedure for evacuating people from the building) 6 % answered negatively in both EPZ, 52 % of the schools in the EPZ Temelín and 58 % in EPZ Dukovany

answered they had only basic data. Complete evacuation documentation was available in 41% of schools in EPZ Dukovany and 10 % in EPZ Temelín.

Figure 4. Schools evacuation planning in EPZ Temelín

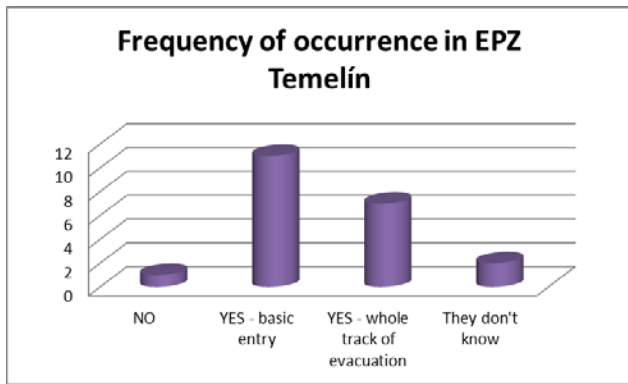
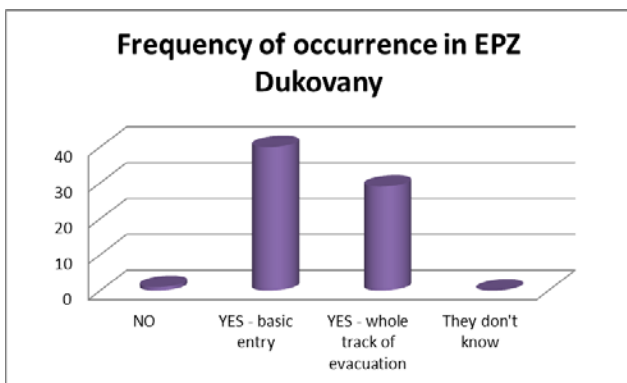


Figure 5. Schools evacuation planning in EPZ Dukovany



The completeness and accuracy of the Fire Evacuation Plan is verified through fire alarm practice. On the question whether the school performs evacuation training answered NO 38 % in EPZ Temelín and 6 % in EPZ Dukovany. YES answered 52 % in EPZ Temelín and 84 % in EPZ Dukovany.

Figure 6. Evacuation practice in schools in EPZ Temelín

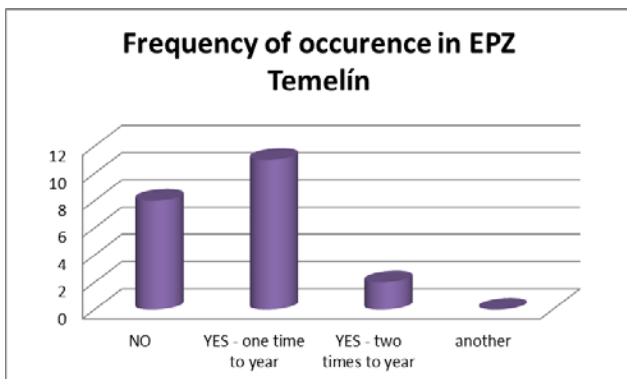
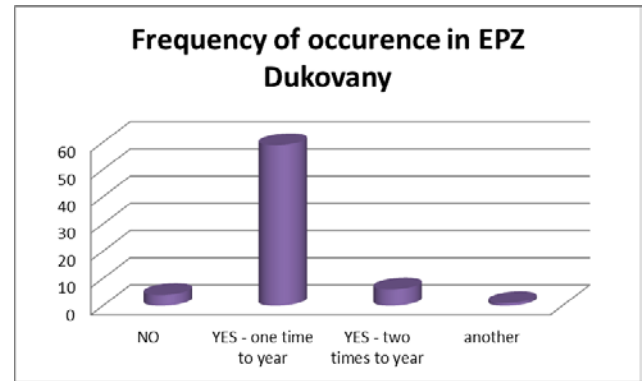


Figure 7. Evacuation practice in schools in EPZ Dukovany



In case of schools evacuation is an important factor whether the school is able to ensure the evacuation by yourself, or will require assistance from the responsible authorities. Assistance during an emergency evacuation will not require 85 % in the ZHP Temelín and 76 % in the ZHP Dukovany; the school is not able to ensure the evacuation of yourself in the 5 % in the ZHP Temelín and 14 % in the ZHP Dukovany; it has not been able to assess 10 % in the ZHP Temelín and 10 % in the ZHP Dukovany.

Figure 8. Need for assistance during an schools evacuation in EPZ Temelín

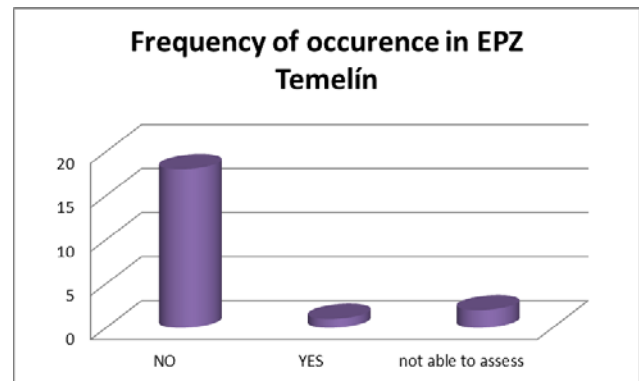
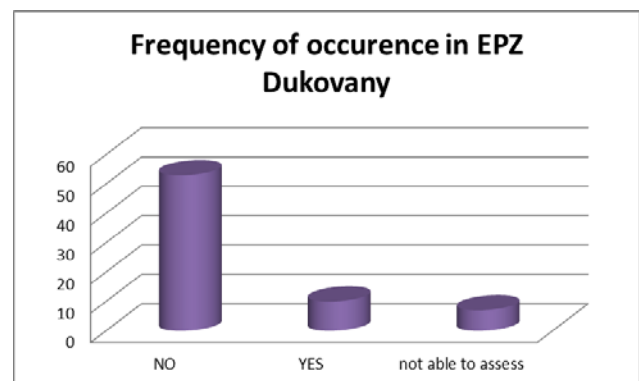


Figure 9. Need for assistance during an schools evacuation in EPZ Dukovany



Evacuation is a process, which is not only the abandonment of the place or object of a threat, but builds on it, the transportation of persons from a place of danger to a place where the people be adequately taken care of. The crucial question in this case is by which means of transport people will be evacuated. Own means of transport has a 0 % in the ZHP Temelín and 1 % in the ZHP Dukovany. The bus will require 90 % in the ZHP Temelín and 90 % in the ZHP Dukovany. A minibus has then 10 % in the ZHP Temelín and 9 % in the ZHP Dukovany.

Figure 10. Means of transport needed for evacuation in EPZ Temelín

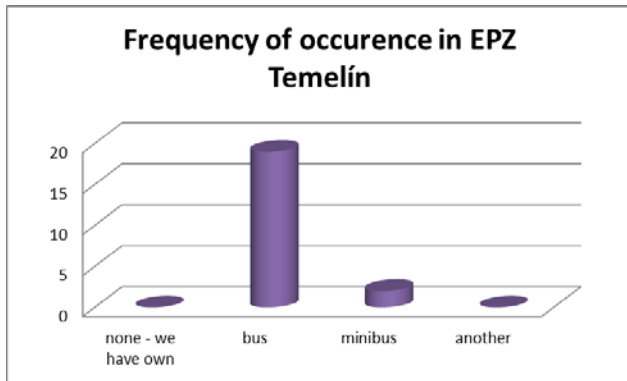
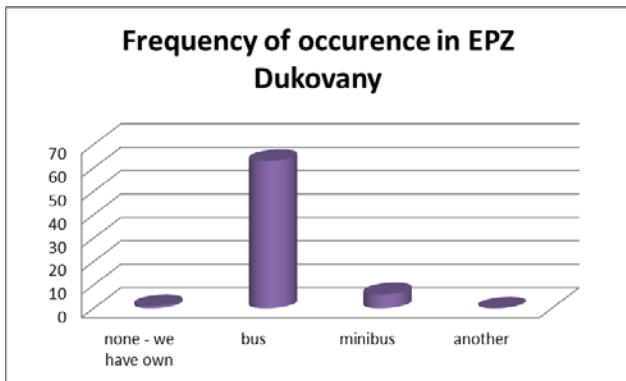


Figure 11. Means of transport needed for evacuation in EPZ Dukovany



The time that will the school need for their evacuation was within 30 minutes at 66 % in the ZHP Temelín and 48 % in the ZHP Dukovany; 1 hour 29 % in the ZHP IS the Temelín and 43% in the ZHP Dukovany; to 2 hours 0 % in the ZHP Temelín and 9 % in the ZHP Dukovany; more than 2 hours 0 % in the ZHP Temelín and 0% in the ZHP Dukovany. I don't know the answer marked the 1 % in the ZHP Temelín and 0% in the ZHP Dukovany.

Figure 12. The time needed for schools evacuation in EPZ Temelín

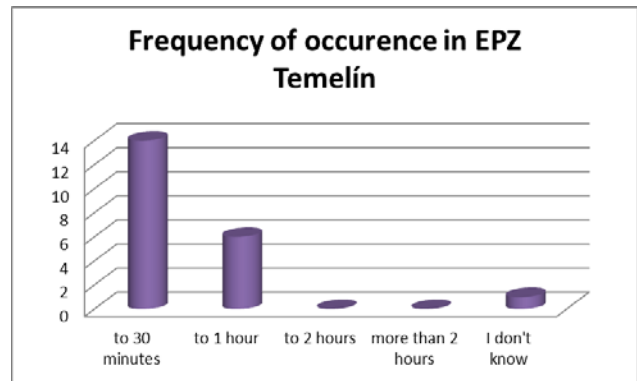
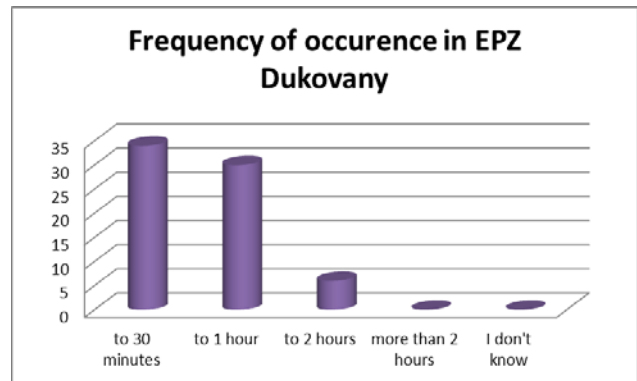


Figure 13. The time needed for schools evacuation in EPZ Dukovany



3.3 Questionnaire for social facilities

The largest proportion of people with special needs in emergency planning zones have retirement homes and homes for persons with disabilities. In these types of social institutions people depend on the help and care of others. [11] These facilities make 91% of all social facilities in the EPZ. The approach taken with these people cannot be the same as with the general population. Their health or mental condition prevent them from fast action, and during compulsory evacuation it is necessary to deal with them sensitively and with due care. In most cases, everyone needs help with transportation from place to place, either manual help or more time for moving. Based on this fact, it was necessary to determine the maximum capacity of clients in social facilities and subdivide them according to the nature of the disability into partially or completely immobile clients.

Figure 14. Total number of social institutions

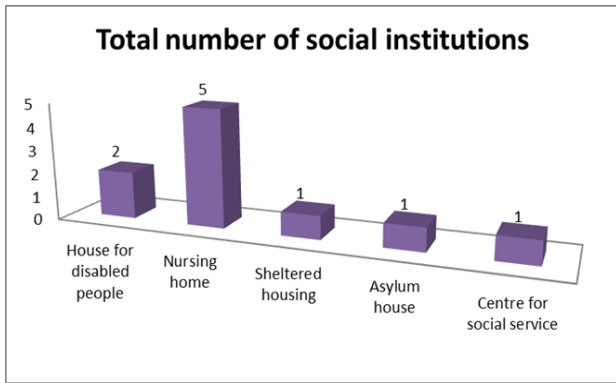


Figure 16. Immobile clients

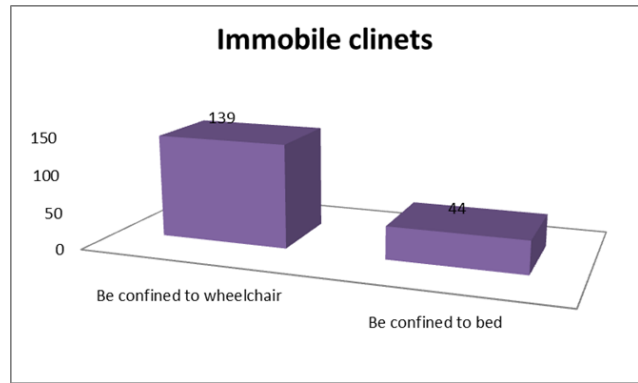
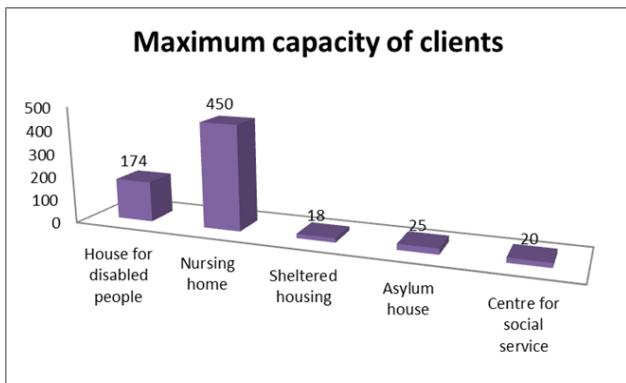


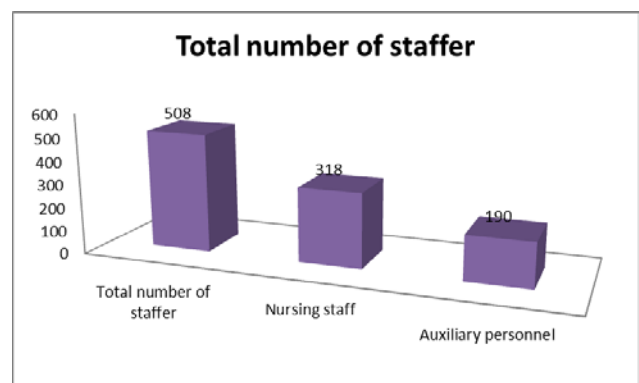
Figure 15. Maximum capacity of clients



To correctly carry out a rapid process of evacuation it is necessary that each facility be prepared for the process of evacuation out of the emergency planning zone and not just for evacuation out of the building as in the case of a fire alarm. Of the total number of facilities, only two have elaborated this procedure.

On average, there is on each home for the elderly in day shift 14 people on the entire facility and 3 people in the night shift. In the social services home for people with disabilities serve in diameter in the day shift 37 people, and in the night shift of 21 people.

Figure 17. Total number of staffer



Of the total numbers of clients in social facilities a total of 20 % are confined to a wheelchair and 6 % to the bed. The largest proportion of immobile clients was found in homes for the elderly. In these types of social facilities there are a total of 27 % of clients confined to a wheelchair and 9 % of clients bedridden.

From the results we can say that assistance is needed in all types of homes for the elderly and for people with disabilities. In total there are five facilities with a maximum capacity of 522 clients. In case of evacuation, the above mentioned facilities will require manual assistance. These refer to the relocation of people from the facilities to the means of transport and subsequent assistance in the evacuation centres. Facilities do not need caregivers or any other kind of assistance during the evacuation. "

IV. CONCLUSION

The results of the project, as it will, though it is currently impossible to predict, will contribute to improving the preparation of evacuation, incorporated in the external emergency plans and emergency plans of counties. Special attention in the project is paid to specific needs of individual age groups and sensitive approach to them while respecting ethical principles in the evacuation of the population.

The severe accidents which happened in Chernobyl caused a huge increase in safety requirements. It is expected that they will be even stricter after the accident occurring at nuclear power plant Fukushima 1. [13] Special attention in the project is paid to specific needs of individual age groups and sensitive approach to them while respecting ethical principles in the evacuation of the population.

Evacuation, as the most effective measure to protect the life and health of citizens, must be prepared and implemented according to the latest knowledge and experience from the Czech Republic and the world, and that is the goal of the research project "Population Protection According to Population Differentiation"

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REFERENCES

- [1] Patočka, J.; Zölzer, F.; Environmental health: acute problems, *Kontakt*, XV/2: 190–202, 2013, ISSN 1804-7122.
- [2] Janoušková, S.; Hák, T.; Lorencová, E.; Vačkář, D.; Návrh koncepčního rámce pro aplikace v České republice, *Obrana a strategie*, Volume 13, Number 2 (December 2013) ISSN 1802-7199.
- [3] Defu, L.; Gulín, L.; Fengoing, W.; Ziyu, Ch.; Risk assessment for nuclear power plants against natural disasters. *Advances in Environmental and Agricultural Science*, 2014 ISBN: 978-1-61804-270-5
- [4] Law no. 239/2000 Coll., about the Integrated Rescue System and some amendments.
- [5] Regulation no. 380/2002 Coll. of the Ministry of Interior, about the preparation and execution of tasks of Population Protection
- [6] Regulation no. 328/2001 Coll., of the Ministry of Interior

on some details of the Integrated Rescue System.

- [7] Regulation no. 246/2001 Coll., on the determination of fire safety conditions and state fire supervision.
- [8] Kratochvílová, D.; *Havarijní plánování*; CPRESS, 2010
- [9] Šilhánková, V.; Pondělíček, M.; Territorial Security in the Planning — Situation in the Czech Republic, Recent Researches in Urban Sustainability, Architecture and Structures; ISBN: 978-960-474-331-5
- [10] Charvátová, M. Brehovská, L.; Educational and Social Facilities Evacuation in the Zone of Emergency Planning, In: *Ochrana obyvatelstva* 2014.
- [11] Law no. 133/1985 Coll. on Fire Protection.
- [12] Brehovská, L.; Identifikace rizik u sociálních zařízení pro případ výpadku elektrické energie jako prevence během mimořádných událostí, *TRILOBIT*, 2/2014, ISSN 1804-1795.
- [13] Toshinsky, G.; Petrochenko, V. Modular Lead-Bismuth Fast Reactors in Nuclear Power. *Sustainability* 2012, 4, 2293-2316.