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Expanding of Compliance Assessment for Preventive Measures of Fire Safety as a Local Facilities with High Risk Level in Ukraine

Abstract: This paper presents the application of agent-based quantitative risk assessment with a fundamental review of public attitudes towards firefighting, a qualitative increase in the level of community responsibility for security. This is the goal that must be set, involving volunteers for their self-organization in matters of fire suppression. Involving volunteers in the task of preventing and eliminating fires will be more effective and will have a more productive result. This will minimize the time of arrival of the first fire-fighting unit to a place of fire or emergency, especially in the countryside. In addition, local, communal, volunteer organizations need to be widely involved in significantly enhancing the culture of safety among people, awareness and responsibility, and improving their personal skills and ability to work in extreme situations.

The process of improving the existing system of supervision over control in the field of fire and technological safety, fire prevention and emergency systems is essential. This would be part of the reform of the State Service of Ukraine for Emergency Situations.

Thus, the assessment of compliance with the level of safety in the local communities, the implementation or use of objects with a high degree of risk, which could endanger the consumer, is classified by the legislation of Ukraine to the legislatively regulated sphere and is mandatory.

Key words: technical regulation, risk, fire hazard, compliance assessment systems.

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Introduction

The purpose of this article is to highlight the lack of security assessment measures at the local level. This is partly due to the reform of the local government administration initiated in Ukraine and the long-term reform of the security block at government level.

In particular, the administrative reform includes transferring the financing of certain security functions to the local level. The moratorium on the verification of compliance with security requirements by the central government deprives control and eliminates the application of preventive measures.

In Ukraine, there is a significant gap in the perception regarding responsibility for the security of local communities by the officials and authorities at all levels. And the same gap is in the lack of normative regulation of the process of transferring responsibility. No less noticeable is the lack of awareness of safety priority in home or industrial activities by the majority of people.

Therefore, the development and implementation of a clear and adapted to local conditions mechanism for assessing the compliance of security measures taken in an industrial institution, city block, village, and whole city will contribute to maintaining an adequate level of security of the populace and territories. One way to achieve this is to use existing methods and means to assess compliance of high risk industrial plants. The article presents justification and methods of such application in the field of fire safety and prevention.

In Ukraine, the activity of voluntary fire protection is regulated at the legislative and sub-legislative, territorial and local levels, taking into account local conditions and needs. Article 27 of the Civil Protection Code of Ukraine defines the bases for the functioning of voluntary civil protection formations [Code 2012].

Also, a resolution of the Cabinet of Ministers of Ukraine dated July 17, 2013, No. 564 "On Approval of the Procedure for the Functioning of Voluntary Fire Protection" was adopted, which approves the procedure for the operation of units of voluntary fire protection [Res. 2013].

Order of the SSES of Ukraine dated July 11, 2016 No. 331 "On Approval of the Partial Studies Plan and Training Program for the Special Training of Local Fire Guards and Members of Voluntary Fire Protection" permits, at the request of local self-government bodies and economic entities, to carry out on a contractual basis special training of local fire brigade personnel and members of voluntary fire protection based on training stations of emergency-rescue detachments of special purpose (units of technical service) Departments of the SSES of Ukraine in the regions, the

Higher Professional School of the Lviv State University of Life Sciences (Vinnytsia) and the Training Center of the Rescue Service of Civil Protection in accordance with the approved Model Curriculum and the curriculum of special training for local fire brigade personnel and members of voluntary fire protection squad.

According to the proposed definition [Draft 2016], voluntary fire brigade is a fire brigade founded by individuals and/or legal entities of private law, the main statutory goal (purpose) of which is to participate in fire prevention, fire extinguishing. Voluntary fire protection by organizational-legal form is formed as a public organization or a public union.

The urgency of creating such formations is that it is possible to avoid injury to people during fires, prevent significant material damage, if the elimination of fires began at the initial stage of their occurrence. A local level of fire safety can only be increased by territorial communities themselves by creating voluntary fire brigades, as is the case in developed European countries, Canada and the United States of America. It is actually crucial for local objects with high risk degree.

Foreign experience shows that the most effective way of fire protection locally and in the regions is the organization of voluntary fire brigade (hereinafter – VFB). The VFB abroad has historical roots and national peculiarities. In all countries it is created to unite the efforts of citizens (nonprofessionals) to combat fires. It should be emphasized that voluntary fire brigades exceed the number of professional firefighters and together with them create a sufficiently effective fire safety system. In Ukraine, despite the similar principles of creation and operation of voluntary fire units, there is a low level of fire safety at local communities. The reasons are low material and technical provision of fire brigades. For voluntary fire brigades this is one of the main reasons for their small number and low professional readiness.

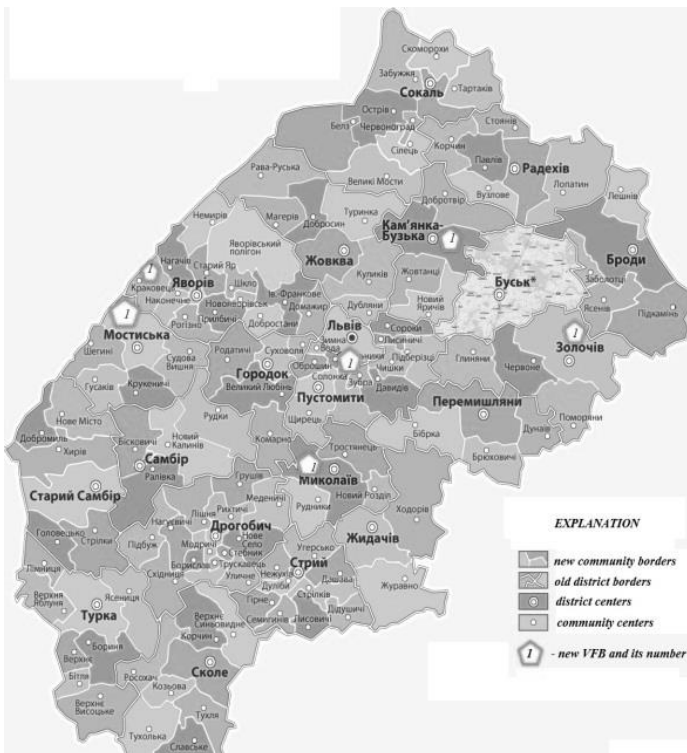
The European fire protection system is based on fire departments of local authorities and voluntary fire brigades. At present, up to 80% of the United Kingdom, Germany, France, and Italy's fire brigades consist of volunteers, indicating the effectiveness of cooperation between professional fire brigades and the community and volunteer organizations in fighting fire and mitigating the effects of emergencies. In Europe, fire brigade volunteers play a more important role than professional firefighters. In each European country there is an approach to the development of voluntary fire protection. In Germany, voluntary fire brigades exist in over 2070 settlements. In Switzerland and Austria, volunteers make up more than 90% of the total number of firefighters, and in Poland there are more than 3.8 thousand voluntary fire brigades. The equipment of voluntary fire brigades is not worse, it is even better than professional ones [Explanatory 2014].

Thus, the aim of the article was to determine functions of the VFB in local communities both for action at the objects with high risk degree and for preventive measures of fire safety on the ground of compliance assessment in technical regulation.

Approachable knowledge

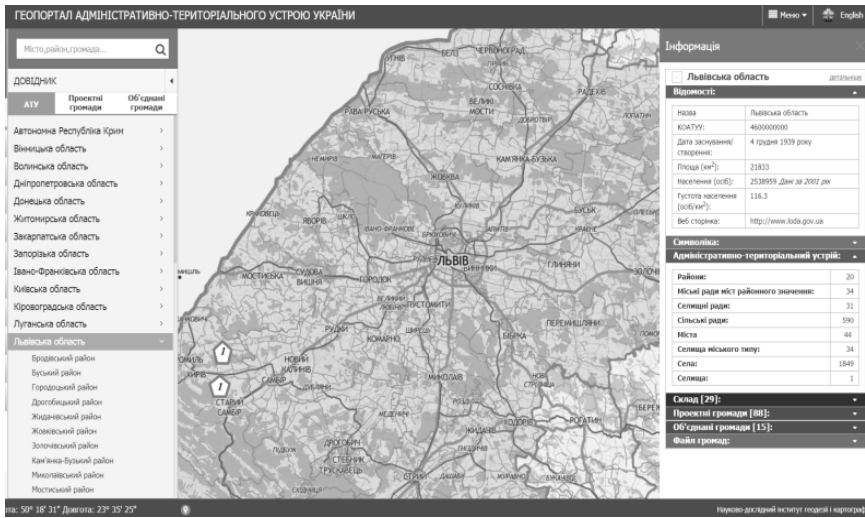
According to the target social program for the development of civil protection of the Lviv region for 2011–2013 and with the forecast for 2015, approved by the session of the Lviv Regional Council dated April 12, 2010, No. 1167, it was planned to create 6 VFB formations, namely in Zolochivsky district (Sasiv village), Kamyanka-Buzky district (Virov village), Mykolayiv district (Ternopillia village), Yavoriv district (Krakovets town), Mostysky district (Cherneve village), Pustomyty district (village Solonka), as shown in pictures 1 and 2.

Picture 1. The map of new VFB, created in Lviv region in 2013



Source: own elaboration.

Picture 2. The map of new VFB, created in Lviv region in 2015



Source: own elaboration.

During 2014–2015, no subdivision of local voluntary fire protection has been created. In connection with the military-political situation in the country, the implementation of the target social program for ensuring fire safety for 2013–2015 on the establishment of subdivisions of local voluntary fire brigades has been suspended.

In accordance with the reform of local self-government and territorial organization of authority, the Decree of the CMU of 11.11.2015 № 1158-p approved a promising plan for the formation of community territories of the Lviv region, according to which the creation of 85 communities is expected.

In 2015, 15 joint territorial communities were created in the Lviv region (Sambir district – 8, Zhydachiv district – 2, Brodivsky district – 1, Mykolayiv district – 1 and Stryj district – 1), in which the first elections were held in October, 2015. On the territory of these communities, there are only two Local FB (Grushatychi and Mizenets villages of Stryj district) with the required 66. As of April 1st, 2016, 16 united territorial communities were created in the territory of the region, in which 64 LFB are planned but not established [Programs Lviv 2017].

By conducting analysis and taking into account the location of the existing state fire and rescue units, local fire brigades, the requirements DNB 360-92** "Urban planning. Planning and development of urban and rural settlements", regarding the normative calculation of the needs of fire depots and the number of fire trucks in settle-

ments, administrative territories and territorial communities were defined, in which additional 762 local fire brigades and 203 units of voluntary fire brigade are required.

According to the regional targeted social security program for the provision of fire safety for 2014-2016, in 2016 funds in the amount of 600 thousand UAH on the formation and functioning of 6 divisions of the VFB were planned [Programs Lviv 2017].

Analyzing the experience of realization of the reform in the Lviv region, it should be noted that on April 8, 2016, the head of the regional state administration and the head of the State Service of Ukraine for Emergencies signed a Memorandum of Cooperation on the organization of measures for civil protection of the population of the combined territorial communities of Lviv region [Programs Ukraine 2017]. In order to ensure an adequate level of safety of the population in the communities, an extensive system of local fire and rescue teams is planned that will be able to arrive at the scene within 20 minutes, while in Europe it is 8 minutes. In addition, within the framework of the reform, it is proposed to organize an active volunteer movement.

As part of the implementation of that Memorandum [Programs Ukraine 2017], a pilot project on organizing measures for civil protection of the population of capable territorial communities was launched. A pilot project started in the Sambir district of Lviv region. The Main Department of the SSE of Ukraine in the Lviv region conducted a dialogue with the leadership of the Babynska, Volya-Baranetska and Chukvyanskaya Territorial Communities on the establishment of local fire brigades. In addition, they allocate special firefighting equipment, fire and rescue equipment, military clothing, helmets that will be transferred to the volunteers in the area. There is also a large-scale work on consulting the representatives of territorial communities in the field of the development of the legal and regulatory component, providing methodical assistance to communities in calculating the optimal number of local civil protection services, which should be established at the level of each united community, taking into account their technogenic load.

Within the frame of the reform of local self-government and decentralization of authorities, the process of reforming the system of the State Service of Ukraine for emergencies is underway. Hence, on September 15, 2016, the Minister of Internal Affairs of Ukraine announced the reform of the SSE of Ukraine. One of the stages of the reform is the decentralization of the system and the creation of integrated fire brigades with the participation of volunteers.

It is worth pointing out that in European countries and the United States, the moral encouragement of volunteer firefighters in the form of awards, honors, and public gratitude is widely used. A feature of the VFB in European countries is that

volunteer firefighters create public associations (unions, associations, etc.) together with professional firefighters and scientific and technical organizations specializing in the development and production of fire-fighting equipment. For Ukraine, in the context of adapting the experience of foreign countries, it is important that the improvement of fire protection lies in the area of authority decentralization and the increase of local self-government bodies through their financial autonomy. Only then can the issue of qualitative provision of the establishment and operation of the VFB be resolved, attract the necessary funds for this and provide appropriate social benefits and preferences to the members of these wives. The development of local self-government will allow us to quickly solve all issues that concern community members and will enable them to influence the level of their well-being. State interference in this process should be minimal.

The reform of decentralization of government will ensure adequate funding for voluntary fire brigade units from local budgets to protect the lives of people and property of territorial communities.

Rescuers conduct work on the creation of voluntary fire brigades based on the actual units of local fire brigade and initiate amendments to the relevant legislation. This will allow local authorities to recruit voluntary fire brigades members who have been trained and tested on the specialty "firefighter-rescuer" on the basis of training units of the territorial divisions of the SSE of Ukraine in accordance with the established procedure.

The state of things

Fire broke out on the night of June 14, 2017 in a 24-storey residential building in the west of London. Grenfell Tower was built in 1978, and it consisted of 127 apartments. Residents say that the fire alarm was not working in the house. It is also noted that British high-rise buildings do not install systems for extinguishing fires.

The inhabitant of Grenfell Tower testifies that the fire stairs were covered by a fire: "There was no fire outlet, because these stairs were in the fire. The house was recently repaired, the outside lining was fit with some plastic from above and replaced the windows, and the fire went under this new lining, which stayed on the wooden slats, and almost all the residents of the house were worried about this, we had a meeting about this repair, and we were afraid that this could happen. We were all impressed by how quickly the fire broke out: first there was nothing – and then everything is burning! At first the fourth floor was on fire but the whole house is very big ...". Another young man who heard screams about the fire in the apartment opposite,

thought to stay in the apartment. Then a fire alarm rang, and they decided that they had to leave. It seems that the firefighters could not get to the fire crane – whether it did not work, or they could not open it... It turned out that the fire started in the kitchen, and then the fire through the window began to spread through the lining, which was only recently put there... and, apparently, the fire outlet also burned, so people from above could not go down, and the firefighters were not able to get up [Експерт про пожежу в Лондоні: двері мали стримати вогонь 2017].

Picture 3. Photos of Grenfell tower fire inside and outside



Source: BBC 2017.

According to several eyewitnesses, the fire quickly spread throughout the building after the lining flared up. The fire quickly spread from the fourth floor to the eighth, then to the corner of the building, and then turned over to another corner. The witnesses saw that the high-rise building of the Greenfield Tower was on fire from one side – from top to bottom, but only on the one side, and as the fire flipped over to the other sides.

Nearly 250 London firefighters tried to extinguish the fire for almost ten hours. Forty firefighters and more than 100 physicians worked on the site. To extinguish a fire on high floors, which is not reached by the spray of the fire brigade, fire can only be dealt with by getting to it from below – there are no other ways. As of the evening of June 14, the firemen did not succeed in completely extinguishing the flames. On June 15, rescuers suspended searches because of a high probability of collapse of the building. After all, approaching the edges of a burned building is dangerous. More than 120 families were left without a roof over their head and are housed in public centers [Wikipedia 2017].

The British security standards should allow the occupants of the high-rise building in which the fire occurred wait for the firefighters, or leave the building unhindered, told BBC Robert Tavener, retired fire inspector. Previously, the rules of fire safety of the buildings cover only what happened inside the building, and not outside. If the fire is exterior, then you can go back and walk – ways of leaving, corridors and stairs should be free. Judging by the way the fire was propagating, whether the Grenfell Tower was in line with the fire requirements was rhetorical, the facing could have been made of plastic, but residents could still evacuate when they saw the fire from the outside.

The expert clarifies that according to the British rules, fire safety in buildings provides fireproof hermetic doors in apartments and stairs. The apartment doors restrain the fire for an hour, and if the fire originated in another apartment – and its door also held back the fire – then you have two hours. Doors are tested for compliance with British fire regulations. That people were told to stay in apartments as it is a rule. The design should allow remaining in the apartment for two hours, waiting until the fire fighters are dealing with fire. The same doors must isolate the fire stairs [*London fire: a visual guide to what happened at Grenfell Tower 2017*].

The fire department does not currently confirm that the fire started on the fourth floor caused by the ignition of a refrigerator. The Greenfell Tower Association of Citizens has repeatedly warned the company responsible for the management of the facility about the threat to people's lives due to the unsatisfactory state of fire safety. Experts on fire safety were surprised with the speed at which the fire spread throughout the house. In many reports, interviewed local residents blamed for the spread of fire tile, which the house had completed to cover just over a year ago during a major overhaul of almost 9 million pounds.

Research and outcomes

As it appears, there is a problem of coordination for the local level of measures and actors to prevent fires – the function of monitoring compliance with fire regulations and rules. In Ukraine, as can be seen above, the permanent reform of supervisory bodies, both in consumer policy and in life safety, leaves local communities without proper protection. No draft legislation on this subject is covered in public discussion. If the organization of rescue and extinguishing of fires is still in the process of transformation, the preventive direction of work to prevent the emergence and minimization of the consequences of emergencies remained individual.

Given the passage of qualitatively different changes and types of influence, it is possible to consider fire, chemical leak, radiation and other types of hazards. Causes of hazards can be found both in the object under study and in the surrounding objects. The selection of the assessment procedure may affect the situation in which the possibility of causing damage occurs. Evaluation management can be carried out both from the inside of the object and from outside of its limits; Individual evaluation and management functions can be combined. Different management strategies have a different effect on the object.

To assess the effectiveness of management the concept of "risk" as a measure of hazard under a different management strategy can be introduced, including the risk of lack of management. Risk is a measure of hazard that characterizes the possibility of causing harm and its severity. It is assumed that it is possible to estimate the scale of the damage – its severity. This definition includes, as a separate case, the application in practice of risk assessment methods as a mathematical expectation of a loss [Emelyanenko 2012].

In general, the concepts of "risk" and "hazard" complement each other. Most often, the risk acts as a characteristic of change (risky actions), and hazard – as a characteristic of the state of the object (a hazardous factor). The practice shows that zero risk in the existing technical systems is impossible to provide. The global recognition has received the concept of tolerable (acceptable) risk. The content of this concept is the pursuit of low safety. This permissible risk is provided through the technical, economic, social and political directions of human activity. Tolerable (acceptable) risk of an accident is a risk, the level of which is permissible and justified on the basis of socio-economic considerations.

The high risk degree of the operation of an object is acceptable if, for the benefit of the facility, the society is ready to take this risk. Thus, acceptable risk represents a certain compromise between the level of safety and the possibilities of its achievement. It is now assumed that for the action of man-caused hazards in general, an individual risk is considered acceptable if its value does not exceed 10^{-6} . Risk is the possibility of occurrence and probable magnitude of the consequences of negative influence over a certain period of time. In some countries, the tolerable risks are set by law. The range of acceptable risks varies from a maximum of 10^{-6} per year, to a minimum of 10^{-8} per year. For ecosystems, the tolerable risk is equal to the amount at which 5% of the species of biogeocoenosis can suffer. Ukraine has declared such an approach in technical regulation, but statistics show that the real risk of death is higher by 10–100 times [Rudyk 2010].

Safety is closely linked with the economic aspect of the activity of a particular industrial enterprise, so it cannot rise to infinity. With an increase of safety costs social risk rises, but technical risk decreases. The growth of social risk means that the company is forced to spend money on solutions for questions of reducing the technical risk, while it reduces the payment of social issues. Of course, the overall social risk in society is reduced. This defines the emerging contradictions between the interests of individual enterprises and society.

The Law of Ukraine "On Hazardous Objects" [2001] defines the tolerable risk – a risk that does not exceed the maximum permissible level in the territory of an object of increased hazard and/or its borders. The same law states that risk management refers to the decision-making process and the implementation of measures aimed at ensuring the minimum possible risk.

Knowledge of individual risk does not allow us to judge the scale of disasters. 10 deaths could be recorded in one of 10 accidents or catastrophic accidents. Therefore, the concept of "social risk" is introduced.

Social risk is defined as the dependence of the risk (frequency of occurrence) of events occurring in the damage of a certain number of people exposed to the striking influence of a definite species, when realizing certain hazards from this number of people. It characterizes the scale of catastrophic hazards.

The hazards and risks associated with them are everywhere, but when known measures can be taken, they minimize or eliminate the risk. Walking down the stairs is followed by a risk of falling, but the probability of this is negligible. Ladders are dangerous, the probability of injury is known as a risk.

Risk management is based on achieving a certain level of safety, the balance of benefits and costs within an individual object, territory and the state as a whole. At the same time, risk management mechanisms aimed at reducing their values have not been widely practiced. Thus, quantitative risk assessment is used only in selected areas, namely, in the analysis of the safety of nuclear power plants, the declaration of safety of high-risk objects. The main mechanisms of state regulation in the field of risk management are state standardization, certification, state expertise, state supervision and control, licensing, economic regulation, declaration of safety of dangerous objects and insurance.

These mechanisms are based on the introduction of protective measures in the characteristics of products or systems that remain more effective, as experience shows that even well designed software can be dropped or overcome, or information for improvement may not be applicable.

The provision will be applied to provide safety in all cases of the project, which will not make it possible either to sufficiently reduce the risk or eliminate hazards. Supplementary protective measures involving additional equipment may increase safety.

Relatively low reliability of the effect of information for improvement is expected, which may consist of organizational measures, proper behavior, attentiveness, the use of personal protective equipment (PPE), skill and training, compared with proven technical protective equipment. Information for improvement will not be a substitute for the correct use of safety precautions by project measures, provision or supplementary protective measures.

On the one hand, the degree of risk exposure to achievement of goals, and the other the degree of uncertainty, which is determined by the risk itself, should be distinguished. For example, the risk of using improper quality raw materials which allows to reach the ultimate goal has a very significant impact, but assume that the probability of such a risk is low, then their product will indicate an insignificant level.

Conclusion

A fundamental review of public attitudes towards firefighting, a qualitative increase in the level of community responsibility for safety – these are the goals that must be set, involving volunteers for their self-organization in matters of extinguishing fires. Involving volunteers in the task of preventing fires will be more effective and will have a more productive result. In addition, local, communal, volunteer organizations need to be widely involved in significantly enhancing the culture of safety among people, awareness and responsibility, and improving their personal skills and ability to work in extreme situations.

1. The process of improving the existing system of supervision over control in the field of fire and technological safety, fire prevention and emergency systems is essential. This would be part of the reform of the State Service of Ukraine for Emergency Situations. One of the steps in this reform is the use of existing methods and means of assessing compliance of high-risk facilities at the local level.

An equally important step is the expansion of the network of local fire brigades in the territorial communities and the involvement of volunteers to provide fire protection. This will minimize the arrival time of the first fire-fighting unit to a place of fire or emergency, especially in the countryside.

Thus, the reform of the local self-government institution, the transfer of a number of functions from the state to local authorities, an increase in the financial compo-

ment of local budgets necessarily raise the issue of expanding the network of voluntary fire brigades in Ukraine.

2. The risk as a measure of hazard, characterizing the possibility of causing harm and its severity, depends on the severity (financial expression) of the harm that may result from the danger considered; and the probability of occurrence of that harm is a function from vulnerability to hazard, display of a hazardous event, technical and human ability to avoid harm.
3. The compliance assessment of the safety level at the local object, the application or use of high risk degree objects that may endanger the consumer is attributed to the legislation in Ukraine is mandatory for execution.
4. Accepting the definition of safety as the presence of this system in an acceptable risk (insignificant and/or unlikely) we consider it as an indispensable component of quality. Consequently, quality management involves compliance assessment tools.

Quality management is conducted taking into account a certain level of safety, balance of benefits and expenses within the limits of the separate object, territory and the state as a whole. Quantitative risk assessment, which is used only in selected areas, namely during the analysis of safety of nuclear power plants, declaration of safety of high-risk objects, is supplemented by the main mechanisms of state regulation in the field of risk management: standardization, certification, state expertise, state and market supervision and control, licensing, economic regulation, declaration of safety of hazardous objects and insurance.

Bibliography

Draft Law on Voluntary Fire Protection No. 4011a of 15.07.2016, [online] www.w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=59781, access: 15.08.2017.

Emelyanenko S.O. (2012), *Estimation of fire risk for electrotechnical reasons in residential buildings*, [in:] Emelyanenko S.O., Rudyk Yu.I., Kuzyk A.D., "Fire safety", No, 20, pp. 105–110.

Explanatory note to the draft Law on Voluntary Fire Protection No. 4011a dated July 15, 2014, [online] www.w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=59781, access: 15.08.2017.

Programs of the Main Department of SSES in Lviv region, [online] www.lviv.dsns.gov.ua/en/Programi.html, access: 15.08.2017.

Programs of the SSES Ukraine, [online] www.dsns.gov.ua/ua/Pilotni-proekti.html, access: 15.08.2017.

Resolution of the Cabinet of Ministers of Ukraine No. 564 dated 17.07.2013, On Approval of the Procedure for the Functioning of Voluntary Fire Protection.

Rudyk Yu.I. (2010), *Estimation of the fire hazard of the transient resistance growth in electrical connections* [in:] Rudyk Yu.I., Stolyarchuk P.G., "Bulletin of the National University Lviv Polytechnic", No. 665: Automation, Measurement and Control, pp. 101–107.

The Code of Civil Protection of Ukraine, [online] Code number 5403-VI dated 02.10.2012, access: 15.08.2017.

Експерт про пожежу в Лондоні: двері мали стримати вогонь (2017), "BBC News" [online], www.bbc.com/ukrainian/features-40278834, access date: 18.06.2017.

Grenfell Tower Fire, "Wikipedia, The Free Encyclopedia" [online], www.en.wikipedia.org/wiki/Grenfell_Tower_fire, access date: 18.06.2017.

London fire: a visual guide to what happened at Grenfell Tower (2017), "BBC News", [online] www.bbc.com/news/uk-40301289, access: 04.08.2017.