

AUTHOR'S DESCRIPTION OF A THESIS (PhD)

NATIONAL

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Doctorate Committee

LÁSZLÓ BÉRCZI

Firefighting Major-General

**Equipment system developments increasing safety of the
fire fighter operations under extreme circumstances
in the integrated disaster management system**

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its official evaluations

Budapest

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DEFINITION OF THE SCIENTIFIC PROBLEM

Human history is accompanied by fire. Its "taming", usage under controlled circumstances had an extreme importance for survival and the processes of society, industry and economy. However, its release from the controlled circumstances usually results in destruction, causing risk of loss of lives and commodities. Chances of fire hazard and magnitude of damages have increased in parallel with the development of the civilization, urbanization and the industry.

The task of fire safety is minimization of the risks caused by fire, protection of human lives and commodities. This activity is realized by tight cooperation of three special areas of fire safety: fire prevention, emergency firefighting services and fire investigation. The various forms of the defense against destruction of fire had been present in the entire human history, but the principles of the present operating system originated in the 19th century. Firefighting and fire safety developed in Hungary in organized form in the second half of the 19th century. The system of protection against fires had been modified several times since then, what process is still in progress up to now. An integrated disaster management organization was established on January 1, 2012. This short sentence means a serious modification of the earlier organizational structure, tasks and operational system of the Fire brigades and Civil protection, and consequentially the legislation governing these organizations, creation of new laws and internal regulations; changes of magnitude!

Inuring the Act CXXVIII of 2011 on disaster management and on amendment of the individual related acts (hereinafter: Act on disaster management) resulted in deep changes concerning the tasks and operation of the disaster management organizations. The act states that firefighting and technical rescue are tasks of the government. Based on this, the professional fire brigades of the local governments became under a central state control, and the entire area of Hungary became covered as the operational area of professional firefighting commands. Additionally, the frames of the activities of the fire safety authorities were also revised.

What was the reason for such wide scale changes? In the time of the professional local government fire brigades, finances, operation control and professional management were separated; additionally financial support was not realized in a uniform way because the various local governments had various budgets. In addition, several tragic incidents occurred

recently that pointed out the lack of possibility of strict authority measures, the not acceptable legislation background and gaps in the law.

The state had to take countermeasures after these tragedies and their root causes for sake of safety of the country and its citizens; it led to reorganization of the disaster management organization and within this, the fire safety organization, extension and reinforcement of the rights of the authority. The primary focus is prevention of disasters, and another stressed aspect is expenses of the preventive measures is much less than expenses of fighting, rescue and reconstruction works of an accident. Performing the tasks jointly is much easier in the integrated organization, with respect to the cost efficiency, and the organizational structure is also beneficial for the professional management.

High level defense against fires requires effective operation of the legal and institutional background of the preventive and emergency fire safety, availability of firefighting solutions and technical rescue procedures adjusted to the often extreme circumstances, and availability of the personnel and technical requirements for safe operations. In case of operation of the fire brigades under extreme conditions, the tactics (procedure) of the operations shall be adjusted to the typical sources of hazards, and also the personnel and technical requirements for safe operations.

During my scientific research activity performed during the recent years, I mainly handled the problems of firefighting operations under terrain level and technical rescues because the deep installations such as underground parking lots and underground affect the firefighting technical devices and personnel requirement.

The parking buildings and deep parking lots may supply the necessary conditions of so called "passive traveling", that is parking in the crowded cities. There was an increasing demand for office buildings and blocks of flats, so tall buildings appeared. Elimination of the disasters in these buildings is commenced by the fire brigades in frame of its firefighting or technical rescue activities. The so called extreme conditions occasionally occurring in such buildings mean a new type of task system for the fire fighter staff in action. In this essay, for example the distance of the operation from the firefighting spring-board area is considered as an extreme circumstance - whether it is several floors below the terrain level of 30 meters above. Therefore I think it is important to examine the tactics of the firefighting operation from the aspect of the fire brigades, the possibilities of development of the technical and personnel conditions that are necessary for performance of these tasks.

Our readiness for life saving and disaster management is not overall yet. In my opinion, those rights shall be determined for the fire brigades performing the initial operation that help the technical and personnel conditions of safe operation under extreme conditions. Elaboration of the principles and specific solutions of these development possibilities shall be respected as a continually actual research in my opinion.

Based on the above facts, **the subject of this dissertation** is: Equipment system developments increasing safety of the fire fighter operations under extreme circumstances in the integrated disaster management system.

RESEARCH PURPOSES

1. *Examine and evaluate* the effects of the changes in the preventive and emergency fire safety on the efficient operation of the legislation, the organization and the institute system, and on the volume of the fire fighter operations and technical rescues within the disaster management system renewed in 2012, after evaluation of the legal and institutional system of fire safety.
2. *Identify* the present development directions of the firefighting tactics procedure conditions built on the modernized legislation, organizational and institute system of fire safety, and then *analyze* in details the factors under extreme conditions mainly under terrain level that influence the safety of firefighting operations, and also analyze the firefighting tactics principles and procedure.
3. *Determine* the most important technical and personnel preconditions of safe firefighting operations that require development based on the firefighting tactics principles of the fire fighter operations under extreme conditions; especially to examine and evaluate the applicability of the breathing equipment, the detection equipment system of operations in presence of electric power, the availability of the technical conditions of the technical rescue activity, and the training programs that are absolutely necessary for safe application of the technical equipment.

RESEARCH METHODS

I studied the applicable international and national regulations and textbooks in order to achieve the defined targets. During the research and elaboration of the subject and processing the literature, I used general research methods such as analysis, synthesis, induction and deduction.

I performed participated in continuous consultations with experts in the crew of the National Disaster Management Administration (hereinafter: BM OKF) and its regional organizations, and the professors of the Disaster Management Institute of the National University of Public Service (NKE) and the Military Technical Doctorate School of NKE HHK I studied and evaluated scientific dissertations published in the subject of fire safety.

Most of the information and data used and referred in my dissertation were generated in the BM OKF National Fire Safety Authority (hereinafter: BM OKF OTF) under my control. I participated actively in elaboration of the BM OKF Special regulations regulating the operation procedure of fire brigades under various conditions; due to my national technical manager and national head inspector position I managed the elaboration and their systematic analysis, critical professional and scientific examination of their adequacy.

I also evaluated the works of international and national researchers in order to establish the conclusions and scientific results in this dissertation, and I compared them with the findings of my own research work.

I evaluated in details the fire safety systems operating in each EU member states based on a questionnaire survey compiled by me, including their structure, position and role in the disaster management system, the position and role of the organizations that can be involved in the management of the firefighting operations; the tactical application of breathing equipment, personal protecting equipment and instruments (such as gas detectors, CO meters and electric field strength detectors), the training system for preparation to special (extreme) operations. I was supported by the embassy of Hungary in Brussels in forwarding the questionnaire to the member states.

I used in my dissertation the contents of the articles that I published mainly in the Defense journal (Védelem), the Disaster Management Review journal (Katasztrófavédelmi szemle) and in the on-line data store of the Defense journal. The figures and charts in this dissertation are from the databases available in the BM OKF OTF. The managers of the Disaster Management of Budapest and its predecessor organization gave me significant help in performing the experiments mentioned or referred in this dissertation.

I used in this dissertation the results based on international two-side firefighting conversations and research and development cooperation about technical issues directed toward solving specific tasks based on international connections. Most of the research results published in this dissertation were achieved in the period between 2010-2014.

Most of the results of my professional and scientific activities to develop and modernize the disaster management and fire safety methods have been integrated in the national legislation and institute system, the procedures and the applied methods.

A BRIEF DESCRIPTION OF THE PERFORMED INVESTIGATION, IN CHAPTERS

In the first chapter of my dissertation, after a summary of the international and national research results, according to the determined scientific purposes, I introduced and evaluated the Hungarian fire safety system modernized in the frames of disaster management. After evaluation of the legal and institutional system of fire safety, I *examined and evaluated* the effects of the changes in the preventive and emergency fire safety on the efficient operation of the legislation, the organization and the institute system of the disaster management, and on the volume of the fire fighter operations and technical rescues.

In the first part of the chapter, I briefly introduced the fire safety organizational and operational models used in some EU member states. I also introduced the structure of the national fire safety organization, the legal position of the professional fire brigades, and the fire brigades of the local governments, facilities and the volunteer fire brigades. I evaluated the fire safety situation in 2013 year. I examined the integrated authority system in details in the section about preventive fire safety, the structure and tasks of the disaster management authority organization, the market supervision and sanctioning activities. In the chapter describing the principles of the fire rescue methods, I discussed the possibilities of reducing the arrival times, more effective usage of the available resources and equipment, the number and training level of the personnel, and the means of controlling the operation. I devoted a separate chapter to the evaluation of the modification of dislocation of the fire rescue and application possibilities of the volunteer fire brigades. I also surveyed the consequences of the above control work on the arrival statistics.

In the second chapter of my dissertation, I identified the development directions of the firefighting tactics procedure conditions built on the modernized legislation, organizational and institute system of fire safety, and then *analyzed* in details the factors under extreme conditions mainly under terrain level that influence the safety of firefighting operations, and also analyze the firefighting tactics principles and procedure. Based on my purposes, I examined in details all the results of the modernization of the firefighting tactics in Hungary in 2012.

Concerning the fire safety of deep parking lots, I analyzed in details their designs, the nature of the occurred fires, the technical possibilities of fire prevention, and the tactics of operation of the fire brigades.

In this chapter, I discussed separately the examination of the rules of firefighting in the deep installations of undergrounds and tactically evaluated the firefighting application of dry rising and down vertical lines. I also analyzed the rule system of the National Fire Safety Regulations concerning increasing firefighting safety. The results of the above analyzing, evaluating and elaborating works have been applied in the applicable internal regulations of BM OKF.

In the third chapter of my dissertation, based on the firefighting tactics principles of the firefighting operations under extreme conditions, I determined the most important technical and personnel requirements that should be developed for safe firefighting operations. I examined and evaluated the applicability of the breathing equipment, the detection equipment system of operations in presence of electric power, the availability of the technical conditions of the technical rescue activity, and the training programs that are absolutely necessary for safe application of the technical equipment.

According to my purposes, first I examined the breathing protection requirements that are necessary for safe firefighting operations, the applicability of the active breathing equipment, the differences observed in the operation and user comfort, and in their application durations. I introduced and evaluated the scientific results of the breathing protection experiment performed at operations under terrain level, controlled by me. I also discussed the practical experiences of application of electric field strength detectors. In another section, I discussed the availability of technical conditions of the technical rescue activities. Additionally, I examined and evaluated the importance of training of the personnel in order to increase the safety of firefighting operations under extreme conditions.

SUMMARIZED CONCLUSIONS

1. Modernization of fire safety in the system of disaster management research subject

1. The developed new disaster management system in the emergency and preventive fields is able to perform its tasks more uniformly and more effectively, therefore ensuring fire safety what is an integral part of public safety.
2. The professional fire brigade is an independent state fire brigade organization established for firefighting, technical rescue and fire prevention tasks.

The professional fire brigades of local governments come under a central control. The local governments have a right to establish civil corporation fire brigades, that will be called as local government fire brigades in the future. Their professional management is performed by BM OKF.

3. The new disaster management law solves several problems by ordering fire safety under government control: it enhances a uniform emergency system with the necessary level of control, without local interests. The state-owned fire brigades form a more efficient fire safety organization by more efficient utilization of the available resources and by optimum planning and maintenance of the personnel and equipment, and it also allows more rational utilization of financial resources.
4. Improvement of dislocation of the emergency firefighting has been in progress since 2012. Reorganization of the disaster management system and establishment of disaster management cells may fulfill the purpose of a firefighting unit may arrive in 25 minutes to any citizen in trouble, and it may be 10 minutes in case of 70% of the population.
5. The integrated authority operation has been possible by integration of the specialized areas in an organization. The market supervision authority power was introduced in order to protect consumers and users. The fire safety authority can force restoration of conditions according to the regulations by application of various sanctions. The activities of the fire safety authority are performed for administrative service fees.
6. The fire brigades of the local governments and facilities do not have an independent operation field, but they perform as the primary intervening force in their primary operation regions within the operation area of the professional firefighting commands, under their professional management. The possibility of independent operation means a quality change in the participation of volunteer fire brigades in elimination of disasters.
7. Based on examination of the disasters in 2012 and 2013 it is obvious that the emergency calls reduced in number. The uniform, integrated disaster management performs better than before while the reaction performance is better under the centralized operation control.

I have proven based on the above facts that the fire safety system installed in the integrated disaster management system operates more uniformly and efficiently, and its direct result is reduction of the number of the fire brigade operations and technical rescues.

Based on my scientific researches I made recommendations about the legislative preconditions of performing independent specialist activities in the assumed operation areas of the fire brigade units, and about the order of the applied operations.

2. Development of the firefighting tactics procedure conditions in the area of improving the safety of operations under extreme conditions.

1. In my researches I pointed out that inuring the act on disaster management makes it possible that the operation operations are determined by BM OKF special regulations. New chapters are inserted in the regulations based on the technical development of the past 10 years and the professional experiences collected during operations. The modifications in the tactical procedures serve to increase safety of the operating fire fighters and safe performance of the tasks. In connection to fire fighter operations under extreme circumstances, the fire extinguishing procedures of installations, premises, public utilities and public utility tunnels under the terrain level are regulated, among many other things.
2. Based on my researches, I determined the main features of the deep car parks that influence the firefighting operations and based on this, I found that in case of fires under the terrain level smoke exhaustion cannot or can hardly be solved to support the operations, so orientation, exploration, firefighting and even life-saving is very complicated.
3. I concluded that in training the younger personnel, it is extremely important to educate them about extinguishing fires under terrain level because in addition to the smoke and heat load during firefighting, the very big disaster area is also a problem with its labyrinth-like branches that are similar to the underground-tunnels because escaping may be hard in case of chaotic, improperly planned operation.
4. Based on my research experiences, I came to the conclusion that:
 - (a) The following aspects shall be used in the trainings and practices for operations in subway installations: high number of passengers; "motion" of the crowd under a compulsion to escape; the firefighting tasks are performed in a small area; and it is very complicated to exhaust the combustion products, gases and heat.

- (b) In case of fire of an underground train stuck in the subway tunnel, the intervening personnel has to face an extreme situation because they have to pass big distances and big level distances in narrow tunnels filled by smoke and even this access operation consumes the available resources, so further resources are necessary to save lives of many people and to fight the fire.
 - (c) One of the most important tasks in case of fire in the area of a subway under terrain level is to make sure the operation time of the breathing equipment is long enough to access, to work, to rescue people and to withdraw safely.
5. I made recommendations about making the rising and down vertical dry systems available and applicable for tactical application, based on my researches. The firefighting commander may not responsibly approve application of dry riser pipes of prefab buildings in case of disasters. I found that installation to the handrails is faster and other basic line installation methods. But it has approximately the same value up to the 4th - 5th floor as application of a dry riser line. In case of bigger heights, application of the dry riser line offers a definitely more efficient installation possibility. As a result of my work; the actual National Fire Safety Regulations (hereinafter: OTSZ) already contains and allows keeping the modified dry risers available from the 6th floor.
 6. Based on my research work, a significant new section of the OTSZ was definition of design principles that shall be applied in design of new buildings. The OTSZ contains a whole section about the firefighting technical requirements in relation to fire fighter operation and defines in details the technical parameters of the operation that can be planned and "installed" in advance.

I made specific professional recommendations in my dissertation based on my above detailed research activities about the firefighting tactical principles and procedure for firefighting operations under extreme conditions under the terrain level; about principles and procedures of application of dry riser and down lines for firefighting tactical purposes; and about introduction of the related fire prevention regulations.

3. Improvement of the technical and personal conditions of the safe firefighting operation under extreme conditions

1. In my researches I pointed out that handling an incident what requires compressed air breathing equipment and extreme tasks means a serious problem. I found these incidents typically extend to large underground areas and the personnel has to be appropriately trained.
2. During my researches, after a technical inventions, I have verified the practical applicability of the PSS BG4 breathing apparatus, and after careful evaluation of the results and experiences of the performed practice, these breathing equipment were utilized by the personnel of the fire brigades.
3. I found based on my research work that the compressed air breathing equipment used in extreme conditions cannot perform their task, or can perform it only in a limited way. I pointed out that the Dräger PSS BG4 equipment in case of about 40 l/min breathing rate offers protection for about 4 hours, and based on actual practical experiences I proved that one of the most important problems during usage of the PSS BG4 was a dramatic increase of the breathing air, or its fluctuation depending on the usage intensity. The tests performed in Hungary under my control justified my research results. We made modifications based on the opinion of the manufacturing company, in possession of the results given by them, with respect to them.
4. I came to the conclusion based on my research works that during operating on incident sites, the fire fighters are facing situations in many cases where presence of electric power prevents safe performance of the operations. As a result of this work of mine a decision was made to give theory and practical training to the specialists of disaster management on a special practice ground, and also to install electric field strength measuring instruments in the mobile jets performing primary firefighting and technical rescue tasks.
5. Furthermore I found out that the available vehicles and special equipment in the fire stations are applicable for elimination of the incidents occurring in the traffic and for the technical rescue tasks. The Disaster Management Operation Service and the Disaster Management Mobile Laboratories are also available for support of the firefighting operations.
6. Based on my scientific research work I established that training of the personnel also has an extreme importance in the field of preventive and emergency firefighting. In case of

fire fighter operations under extreme circumstances, special extension courses are necessary.

I made specific professional recommendation based on my research works about application conditions of breathing equipment and about improvement of the equipment according to the technical requirements revealed by the experimental results; about application conditions of the detector used for operations in presence of electric power; and about organization of vital training programs for safe application of technical devices examined in frames of scientific researches.

NEW SCIENTIFIC ACHIEVEMENTS

1. *After an overall and critical examination and evaluation of the legal and institutional system of firefighting based on the disaster management system renewed in 2012, I was the first one who **identified the effects of this modification to the public safety and the safety of the population**, and based on this*
 - a. ***I have proven** that the system operates more uniformly and efficiently than before, and its direct result is reduction of the number of the fire brigade operations and technical rescues.*
 - b. ***I made recommendations** about the legislative preconditions of performing independent specialist activities in the assumed operation areas of the fire brigade units, and about the order of the applied operations.*
2. *After identification and detailed analysis of the factors affecting the development directions of the firefighting tactical procedure conditions, based on the modernized legal, organizational and institutional system of firefighting, and the safety of the intervening forces, and after checking the research results by practical experiments, **I made specific professional recommendations:***
 - a. *about firefighting tactical principles and procedure of the firefighting operations performed under terrain level under extreme condition; and*
 - b. *about firefighting tactical application principles and procedure of using of the dry rising and down vertical lines, and about introduction of the related fire prevention rules.*
3. *Based on the analysis and evaluation of the technical and personal requirements of the firefighting and technical rescue operation under extreme conditions, and after checking*

the research results by practical experiments, I made specific professional recommendation:

- a. about application conditions of breathing equipment and about their improvement according to the technical requirements revealed by the experimental results;*
- b. about application conditions of the detector used for operations performed in presence of electric power, including the procedure and bringing it into service; and*
- c. vital training programs that are necessary for safe application of the technical equipment examined in frames of the scientific researches, and their implementation.*

PRACTICAL APPLICATION OF THE RESEARCH RESULTS

I suggest usage of the results of my research works in the following areas of preventive and especially in the emergency fire safety:

1. Measurement of the preventive and emergency fire safety; correction of the procedures.
2. Elaboration of the considerations and plans that are necessary for determination of the development directions of the firefighting tactics procedure conditions based on the modernized legal, organizational and institutional system for fire safety.
3. Creation and application of the factors affecting the safety of the firefighting operations under extreme conditions, especially under terrain level, and of firefighting tactics principles and procedure
4. Elaboration and introduction of programs with the purpose of improving the technical and personal conditions of safe firefighting operations, with special respect to the breathing equipment, the detection equipment system of operations in presence of electric power, the availability of the technical conditions of the technical rescue activity, and the training programs that are absolutely necessary for safe application of the technical equipment.
5. The results of my dissertation can be used for modernization of the internal regulations (special instructions) of BM OKF.

DEDICATIONS

I dedicate my results and dissertation to the specialists of the Ministry of Interior of Hungary and the National Disaster Management Administration and its regional organizations dealing with fire safety.

I also dedicate my dissertation to the National University of Public Service, the Szent István University, Ybl Miklós Architecture Branch, Fire and Disaster Management Institute, the Disaster Management Training Center, and other high educational institutes, and to the professional disaster management, as a supplementary material, after adequately edited.

LIST OF PUBLICATIONS IN RELATION TO THE SUBJECT OF THE DOCTORAND

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- [3] Bérczi László: Légzésvédelmi kísérlet talajszint alatti beavatkozásnál. Védelem – Katasztrófa- és tűzvédelmi szemle 2012. XIX. évfolyam 4. szám pp. 28-29.
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Not corrected Hungarian language professional journal articles

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PROFESSIONAL-SCIENTIFIC CURRICULUM VITAE OF THE DOCTORAND

Name: László Bérczi Firefighting Major-General

Place and date of birth: Karcag, November 22, 1968

During my almost twenty years long fire fighter career, I collected wide practice and professional experiences in the field of fire safety, firefighting and technical rescue both in Budapest and in the country. I have been working in various manager positions for 15 years now, and have performed as a commander of several great fires and disasters in Budapest.

In addition to the professional managing activities, I participate in training of firefighting and fire safety specialists, in various special courses, I give lectures on professional forums, and I participate in the activities of various professional and civilian organizations.

I am a member of the Disaster Management Scientific Committee, leader of the fire safety work-group, chairman of the Hungarian National Committee of CTIF. As a member of the Policing Exam Committee, Disaster and Fire Safety Sub-commission, I obtained authorization as an examiner.

I published 32 professional publications concerning firefighting and technical rescue.

Studies I obtained a fire safety engineer graduate in the Ybl Miklós Technical College, and then I completed the Zrínyi Miklós University of National Defense, Defense Management branch, Disaster Management faculty and I became a graduate defense manager. At the moment I am a doctorand of the National University of Public Service, Military Technical Doctorate School.

Language skills: I have intermediate level Russian "C" and elementary level "C" English language exams.

Professional career:

- | | |
|-----------|--|
| 1994-2000 | Served in Jász-Nagykun-Szolnok county in Karcag Professional Fire Brigade, as a manager since 1997 (deputy commander). |
| 2000-2000 | Rescue organizer head of department in the Jász-Nagykun-Szolnok County Disaster Management Administration |
| 2000-2001 | Deputy Head of department in the Pest County Disaster Management Administration |

- 2001-2010 Various manager positions in the Firefighting Command of Budapest (district deputy commander, firefighting head of department, team leader of the dispatching center, deputy under-secretary, under-secretary)
- 2010- National fire brigade main inspector of the BM National Disaster Management Administration.

Honors: 2009. Silver grade of the Service Honor; 2010. Honor of the Republic; 2011. Honor of Saint Florian

Budapest, August 15, 2014

László Bérczi Firefighting Major-General