MIKLÓS ZRÍNYI NATIONAL DEFENSE UNIVERSITY
Doctoral Board

PÉTER PÁNTYA

fire lieutenant

Hazard reduction of closed area fire interventions

candidate's synopsis and official reviews of doctoral (PhD) thesis entitled

2011,

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Supervisor:

Dr. habil. OSZKÁR CZIVA ret. fire colonel (PhD)

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DEFINING THE SCIENTIFIC PROBLEM

I have taken a three directional approach to the safety of firefighters. One approach has to do with personal protective gear, which provides a specific level of protection; the next approach is concerned with nonstop drilling, during the course of which the persons involved in the program acquire or maintain skills-proficiency in the use of personal protective gear and conducting fire interventions in a professionally adequate manner. The third approach targets hazardous environment, where the safety of all the firefighters concerned in the area can be improved by decreasing risk levels as much as possible or reducing personal involvement.

At present, standardized personal protective service equipment has been adopted for all Hungarian fire department on-call personnel. The equipments' provision, supervision, and incidental replacement is, as a result, ongoing.

The specified training schemes include the constant and professionally all-around further-training of the firetroops concerned. The special characteristics present in closed area situations can only be addressed in so far as they do not take training time away from other – equally important – training areas. The scarce educational material on closed area interventions and their risks adds to training difficulties. I think that it is important to expand training with regards to closed area-interventions because this is a highly potentially dangerous environment. Thanks to the available mechanical and technical developments the safety of firemen can be protected at a much higher level, yet, these gears can only be used quickly, appropriately and efficiently if the troops using these have previously acquired practice in their use. Proficiency with highest accuracy is fastest learned in real-life or closest to real-life situations. This is more expensive and needs more preparation than classroom lectures, however, it may yield results in the short run.

The following factors may result in safer circumstances and more precise performance: identifying risks, becoming aware of their presence, confidence in knowing that the intervener knows what he has to do and how he has to do it, what are the limits that he is facing and what possibilities he has in case any unexpected event comes up. The question arises: how and to what degree can fireman safety be increased in the above mentioned areas.

RESEARCH OBJECTIVES

- **Giving the definition** of closed area from fire intervention perspective
- **Examining** what effects and risks firemen are exposed to during a fire or harmful event occurring in a closed area.
- **Analyzing** call statistics of the last ten years and drawing conclusions and raising discourse topics
- **Examining** the accident statistics of the past ten years, the circumstances of accidents and raising discourse topics
- **Examining** adverse effects on firemen resulting from use of protective gear
- **Examining** ways of reducing risks of closed are-interventions and increasing safety
- **Examining** implement ability of low cost, low labor multipurpose smoke chamber practice at any fire department
- **Examining** to what degree the intervention skills of on-call troops can be improved on the short and long run – in one of the highly potentially dangerous environments – under conditions requiring respiration protection gears in the case of volunteer and career firemen.

RESEARCH METHODS

I used the following methods in order to gain my research results:

- I strove to utilize, make use of the available, mandatory and elective courses of the Doctoral School during my studies;

- to keep myself up to date on the relevant international and domestic publications.

- I conducted consultations with regards to my research with colleagues at all levels of the profession as well as fellow researchers.

- I analyzed fireman interventions as well as injuries taking place during these; accidents and their circumstances.

- I read about results in similar areas in other countries and examined possibilities of domestic application.

- I studied intervention statistics of fire departments, analyzed different accident reports and drew conclusions from these.
- I used a nearly 100 person sample group to carry out the verification of my hypothesis on in a carefully designed fashion.

BRIEF SUMMARY OF THE RESEARCH BY CHAPTERS

The national firefighter organization is introduced in the **first** chapter and the number of round-the-clock emergency troops is given. This provides a picture of all the personnel – though on different work contracts yet equally at risk from interior fireground circumstances. I described the relevant legal regulations regarding worker safety, establishment and maintenance of service stations, laws governing fire operations and legal and training requirements for qualifying for service.

I have carried out a review of standardized personal protective equipment and interior circumstances.

In the **second** chapter I analyze firefighter interventions. I have looked at mission and accident statistics for the past 11 years. I screened the national accident reports for interior fire events. I drew conclusions with regards to accidents and their reasons in this environment.

In the **third** chapter I examine which are the possibilities trough which we can improve the safety of firefighters entering interior firegrounds. I present the drawbacks of equipments which are standardized at present and point out possibilities for development. I propose the use of remote monitoring systems (with regards to current research), through the use of which the safety of entering-firefighters can be monitored all the way from the external command point. I give an outline of available innovations for reducing interior fireground hazards and direct personnel involvement and give suggestions for their use.

In the **fourth** chapter I elaborate on the possibilities for training in closed spaces in order to improve firefighter safety and efficiency. I examine and present the currently available training methods on interior fireground operations and give their drawbacks and advantages. I present the scientific research conducted in an interior environment under my guidance and provide a summary of the research results.

SUMMARY

The Hungarian rescue fire protection is ensured by career and volunteer (public body) fire departments which are appropriately situated (dislocated). Approximately 2200 people carry out primary intervention tasks on different employment contracts as career, members of a public body or on-site firefighters. Career firefighters must leave barracks within 120 seconds following an alert and head to the indicated site of fire event or disaster. The volunteer and on-site firemen tackle equally dangerous fire and harmful events, although they follow a different alert routine and are on dissimilar work contracts. All firemen are equally at risk from emerging hazards while on fire fighting duty in closed areas. The basic protective equipment is the same, yet, the career personnel are in a better situation with regards to training and practice. In order to be employed in different positions at the fire department one has to meet legal requirements and must hold the proper state and professional certificates, has to pass the physical exam and in the case of the career personnel a clean criminal record and unquestionable personal conduct are requirements for acceptance.

Proper implementation procedure is regulated by an Internal Ministry Decree and the right to safe working conditions is mentioned by our Constitution as well. Concerning the special situation of law-enforcement bodies a decree has been issued by the Minister of Internal Affairs regarding the rules of safe work. The director of National Disaster Recovery has legal authority to enforce the regulation in the National Fire Department.

Firemen extinguishing fires and doing technical rescue work in closed areas face dangers from many directions compared to an open area and the work of these firemen are made more difficult by many circumstances. These dangers present are greater heat load, decreased visibility, unknown materials and structures, limited possibilities for transportation, escape, and ventilation and respirator deployment. Wearing personal firefighter safety equipment generates such further loads for those wearing them like significant weight burden, heat load, limited visibility and perception, communication difficulties, risk of getting pinched or tripped. This is coupled by the stress resulting from the awareness of hazards and the dangerous nature of tasks.

Fire missions that need to be done in closed areas and the relevant safety requirements are very succinctly addressed by the Fire Extinguishing and Technical Rescue Code. By

analyzing the last ten years' data we can observe that interventions in built-up structures, respirator deployments and number of used up oxygen tanks in proportion with these have been on the rise.

The basic and in-service firefighter trainings provided as called for by the law. There is a chance to give detailed training on a wide range of firefighter tasks and duties according to the needs of any given fire department at the annual in-service trainings. Preparation for intervention under special circumstances such as closed area intervention, especially one requiring the use of respirators and in reduced visibility is presently required neither in the boot camp nor during the annual in-service trainings. The organizers of basic trainings and the commanders of fire departments solve the preparation for such situations at their own discretion. The Directorate of the National Disaster Recovery has been putting increasing emphasis on situation exercises a part of which are interior missions using respirators. A good example for this is the preparation of emergency troops for missions in a smoke filled environment, taking place in an organized and ongoing manner at the Budapest Fire Command Center which is greatly aided by their own psychical training track. The continuous participation of all firefighters or, at least, of the professional firefighters in similar exercises under varied circumstances is presently not required or facilitated at a national level.

The fire extinguishing and technical rescue operation tendencies have turned around years ago, therefore, today rather the technical rescue missions are predominant, a large percentage of which involve intervention at road accident sites. The most dangerous events are fires and there are over ten thousand fire event interventions on an annual basis. Looking at the past 11 years' statistics there have been 5-600 casualties and 100 deaths due to fire incidents annually which is indicative of the dangerousness the working environment and the stress levels. Over the course of the last 10 years firefighters suffered injuries 40 times per year on average due to (presumably) closed area fires and the stats are similar for technical rescues, too. The figures with regards to closed area incidents I am providing here are not specific in any degree because the statistical records cannot be screened exclusively for closed area occurrences.

Out of the five most serious, fatal casualties, four were due to smoke poisoning and one other was choking following panic and disorientation. Most common causes of firefighter

injuries listed by order of frequency: falling over, bumping, falling down, stabbing/cutting, material slips and slides, structural collapses as well as getting burned and hit by explosions. It would be very advantageous if, in the course of collating statistical data, events were described more in detail to help future research and control. Indicating whether injuries were suffered in a so-called constricted body position or if they took place in a confined space would provide such further helpful details. During the in-detail interpretation of materials on firefighter casualties I paid special attention to injuries which verifiably took place in closed spaces. The most common injuries suffered under these circumstances are: diving down, getting burned, smoke poisoning, lacerations/stabs, structural collapses, electroshock, movement injuries (sprains, fractures) and different unexpected incidents such as getting attacked by people.

Firefighter protective equipment is under constant development. The available increasingly modern personal protective gears provide greater comfort as well as a wider range of and more effective protection for the user.

I think that there are three areas where the safety of firefighters in closed spaces could be improved. **First,** we should find the more modern versions of personal protective gears and equipments used in closed spaces and standardize them once they have been tested by firefighter squads. Improvement of passive and active visibility, more sophisticated and multifunctional respirators, general purpose heat cameras or respirators enabling long mission time which are reservable for rescue missions can be mentioned in this regard. The different telemetric systems are used especially to reduce closed area risks since the surveillance, supervision and advising of entering firefighters. There are some very promising developments in this field and soon it will be possible to follow movements of persons within buildings. **Second,** we should train firefighters on interior operations in trainings as realistic as possible. **Third,** hazard reduction of interior operations can be achieved by adopting such new equipments as have not yet been standardized by Hungarian fire departments, however, either the given circumstances can be made safer or direct personnel involvement can be reduced through their use. I recommend here attacking the fire trough the outer wall, using overpressure ventilation and deploying remote-controlled fire extinguishing or rescue devices. The more wide spread national standardization of different types of special support poles, glass-securing foils or recording or video footage of certain operations are worth mentioning here.

Trough research and development projects serving national defense purposes in Hungary ownership costs could kept at a lower level on the long run compared to procurements through purchases. Meeting local demands would be more effective in this way, which would be another great advantage.

Training is one of the very effective ways of improving the safety and risk reduction for firefighters who are attending interior firegrounds. Current training schemes include training on a wide range of operations which take place at the sites of fire departments and the applied training methods vary by each fire department. Training possibilities on interior operations are limited. This type of training is not equally available for the different professional firefighters and the volunteer and on-site firefighters are in an especially difficult situation in this regard. The available training methods: simple drills organized at local facilities, immobile fire simulation containers (for example the ones that can be found at the National Disaster Recovery Training Center, Danube Refinery and Power Plant Fire Department), psychical training tracks, (Budapest Fire Command Center, Airport Disaster Recovery Directorate, to name a few examples) as well as the built, solid-wall training track of the National Disaster Recovery Training Center. I have suggested that the fire departments use the light-structure, low-cost fire simulation containers which are common training tools in the USA and have been successfully adopted at several places in Hungary as well. The development of interior fireground scenes can be closely followed with their help and they also facilitate the testing of different intervention methods.

I have, throughout my research, developed and conducted an experiment during the course of which I was able to provide a kind of training for the emergency troops of several fire departments – with nearly 100 participants – where participants acquired complex skills in interior fire extinguishing operations. I was able to come up with results which prove that with significantly low investment it is possible for any fire department to conduct such a training practice where all the relevant personnel can solve specific tasks within a matter of few days on several occasions.

The certain training tasks can be altered according to training goals, new tools can be tested, and their use can be mastered by all participants. The entire process of the training session can be supervised properly; the performance of the trainees can be monitored, measured and recorded. Firefighters can be trained in almost real-life, yet, completely safe

situations. These methods can be mastered by the firefighters to such an extent that they become lasing skills. Personnel operational efficiency significantly increases, and so does the safety with which they carry out their tasks. Thanks to the training, they use up less oxygen during a shorter operational time, which mean valuable minutes considering their limited, 30-40 minute breathing capacity. These valuable minutes have life or death importance for both the firefighter and the victim to be rescued.

NEW SCIENTIFIC RESULTS

1. I am the first person to construct the definition of "closed area relevant with regards to firefighter intervention" according to which *a closed area - from a firefighting and loss-recovery perspective – is an area enclosed by a wall of any material and construction (may even contain several rooms), where entrance and exit is possible only trough limited points of passage and passage through the walling is only possible by wrecking the wall.*
2. Based on the analysis of statistical data from the past 11 years I have arrived to the conclusion that operations in built-up environment and in closed spaces increase the number of injuries more than the general firefighter interventions.
3. I have developed a training and in-service training method following the research series for firefighters by which their performance can be equally measured and their development can be compared so that more conclusions could be drawn.
4. I conducted research in order to prove that the by providing continuous training on interior operation there is improvement in the oxygen use, task completion, pulse rate change for the entire emergency standby troop. I have proven that the results can be further improved with regular, scheduled practice.

PROPOSALS, SUGGESTIONS

- I suggest that the definition of "closed area"- which I constructed - be taken into account concerning intervention operations.
- I suggest the exploration of methods, modes of behavior and solutions by which interior operations can be more safely and effectively carried out. There should be

further research on pulse rate-changes and on the analysis of the results of psychological stress and immune competence tests (PIT).

- I propose the creation of a research and development workshop which would cater to the needs of the entire law enforcement field. The creation of such a training center is necessary where any emerging working condition in the law enforcement field can be simulated, documented, practiced and monitored. Courses of secondary and higher educational facilities could be tied into this training.
- I propose the facilitation of training on interior operations using respirators involving all emergency standby troops in an organized fashion and on a regular basis. A solution for this could be a centrally issued, unified methodical guideline for the use of methods I have suggested (light-structure fire simulation-container obstacle courses, smoke chamber practice).
- I further propose that the current statistical databases be expanded and that the accident report data sheets be made more detailed.
- I propose that preparation for interior circumstances be made a mandatory part of basic firefighter training.
- I propose the consideration for standardization and implementation of the firefighter equipments presented in my thesis (exterior firefighting tools, remote controlled robots, telemetric systems, heat cameras etc.)

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Professional and scientific resume

Personal details:

Name: Péter Pántya fir. lieutenant

DOB.: 1978, Berettyóújfalu,

Phone: 70/330-7983

E-mail: panpet1@freemail.hu

Education:

2008-2011 Miklós Zrínyi National Defense University, Military Technology Doctoral School, PhD student

2008-2010 Miklós Zrínyi National Defense University, János Bolyai Department of Military Technology, defense manager (fire protection and firefighter), grade: A+

2006-2008 Miklós Zrínyi National Defense University, János Bolyai Department of Military Technology, certified defense manager (specializing in disaster recovery), grade: A+

2003-2006 Sámuel Tessedik College, Dept. of Economics, personnel organizer,grade: B

1995-1998 I. György Rákóczi Gymnasium, Derecske

Courses and language studies 1994-2008-ig (work safety technician, IT mechanic, software operator).

Language skills:

English intermediate B	2005
English intermediate A	2004
Esperanto intermediate C	2003

Professionalexperience:

2007- Professional City Council Fire Department, Berettyóújfalu, Hungary senior personnel and labor executive

2003-2007 Professional City Council Fire Department, Berettyóújfalu, Hungary employed firefighter

2002-2003 Professional City Council Fire Department, Berettyóújfalu, Hungary employed firefighter (civil service)

Successful participation at county level professional contests, first place.

Scientific activities:

2006–2008 Participation at the MZ National Defense University Student Conference on three occasions, participation and honors at the National Scientific Student Conference

2009–2010 Participation in the János Bólyai Artificer Awards and the Dr. Imre Balogh memorial competitions

22 May, 2011, Berettyóújfalu

PÉTER PÁNTYA fire lieutenant