



ВИСОКА ТЕХНИЧКА ШКОЛА
СТРУКОВНИХ СТУДИЈА



TECHNICKÁ UNIVERZITA VO ZVOLENE

4. МЕЂУНАРОДНА НАУЧНА КОНФЕРЕНЦИЈА

БЕЗБЕДНОСНИ ИНЖЕЊЕРИНГ

ПОЖАР, ЖИВОТНА СРЕДИНА,
РАДНА ОКОЛИНА, ИНТЕГРИСАНИ РИЗИЦИ

И

14. МЕЂУНАРОДНА КОНФЕРЕНЦИЈА

ЗАШТИТЕ ОД ПОЖАРА И ЕКСПЛОЗИЈЕ



НОВИ САД, 2-3. ОКТОБАР 2014.

ЗБОРНИК РАДОВА BOOK OF PROCEEDINGS

4th INTERNATIONAL SCIENTIFIC CONFERENCE

SAFETY ENGINEERING

FIRE, ENVIRONMENT,
WORK ENVIRONMENT, INTEGRATED RISK

AND

14th INTERNATIONAL CONFERENCE

FIRE AND EXPLOSION PROTECTION



NOVI SAD, 2-3. OCTOBER 2014.

**ВИСОКА ТЕХНИЧКА ШКОЛА СТРУКОВНИХ СТУДИЈА У НОВОМ САДУ,
ОДСЕК ЗАШТИТЕ,
НОВИ САД, РЕПУБЛИКА СРБИЈА**

**ТЕХНИЧКИ УНИВЕРЗИТЕТ У ЗВОЛЕНУ
ТЕХНОЛОШКИ ФАКУЛТЕТ ЗА ПРЕРАДУ ДРВЕТА
ОДСЕК ЗАШТИТЕ ОД ПОЖАРА,
ЗВОЛЕН, РЕПУБЛИКА СЛОВАЧКА**

**УНИВЕРЗИТЕТ У НОВОМ САДУ, ФАКУЛТЕТ ТЕХНИЧКИХ НАУКА
ДЕПАРТМАН ЗА ГРАЂЕВИНАРСТВО И ГЕОДЕЗИЈУ
НОВИ САД, РЕПУБЛИКА СРБИЈА**

ЗБОРНИК РАДОВА PROCEEDINGS

4. МЕЂУНАРОДНА НАУЧНА КОНФЕРЕНЦИЈА

БЕЗБЕДНОСНИ ИНЖЕЊЕРИНГ

**ПОЖАР, ЖИВОТНА СРЕДИНА, РАДНА ОКОЛИНА, ИНТЕГРИСАНИ РИЗИЦИ
И**

14. МЕЂУНАРОДНА КОНФЕРЕНЦИЈА

ЗАШТИТЕ ОД ПОЖАРА И ЕКСПЛОЗИЈЕ

4th INTERNATIONAL SCIENTIFIC CONFERENCE ON

SAFETY ENGINEERING

**FIRE, ENVIRONMENT, WORK ENVIRONMENT, INTEGRATED RISK
AND**

14th INTERNATIONAL CONFERENCE ON

FIRE AND EXPLOSION PROTECTION

Нови Сад, 02-03. октобар 2014.

Novi Sad, October 2-3, 2014

Издавач:

ВИСОКА ТЕХНИЧКА ШКОЛА
СТРУКОВНИХ СТУДИЈА У
НОВОМ САДУ
21000 Нови Сад, Школска 1
Србија

Publisher:

HIGHER EDUCATION TECHNICAL
SCHOOL OF PROFESSIONAL
STUDIES, NOVI SAD
21000 Novi Sad, Školska 1
Serbia

За издавача:

Проф. др Бранко Савић,
директор Школе

For the publisher:

Prof. PhD Branko Savić
General menanger of the School

Одговорни уредници Зборника:

Проф. др Верица Миланко
Доц. др Мирјана Лабан
Инг. др Ева Мрачкова

Editors:

Prof. PhD Verica Milanko
Ass. Prof PhD Mirjana Laban
Ing. PhD. Eva Mračkova

Техничка припрема и дизајн:

Ак.Спец. Наташа Субић

Prepress:

Ac.Spec. Nataša Subić

Дизајн корица:

Денис Иванов

Cover design:

Denis Ivanov

Штампа:

Штампарија Високе техничке школе
струковних студија
у Новом Саду

Printed by:

Higher Education Technical School Of
Professional Studies
Novi Sad

Тираж:

150 примерака

Circulation:

150 copies

Нови Сад, 2014.

Novi Sad, 2014

ORGANIZERS OF THE CONFERENCE



The Higher Education Technical School of Professional Studies in Novi Sad, Serbia, founded in 1959, fulfills its mission in higher education, fields of expertise and research in order to apply the acquired knowledge.

It educates engineers at four Departments in 20 accredited study programme of professional bachelor and specialist studies.

In the Department of Protection Engineering the following areas are studied:

- Fire protection,
- Occupational health and safety,
- Environmental protection, and
- Civil protection and emergency rescue.

Since 2010 Fire Protection and IT studies are accredited distance learning programme. The continual application of modern scientific, technical and technological processes of production and business increases the quality of activities in the School.



TECHNICKÁ UNIVERZITA VO ZVOLENE

The main mission of the Technical University from Zvolen is to provide university education in accredited study programme as well as to develop scientific research in different fields of industry. The Technical University in Zvolen comprises four faculties: the Faculty of Forestry, the Faculty of Wood Sciences and Technology, the Faculty of Ecology and Environmental Sciences, and the Faculty of Environmental and Manufacturing Technology.

The continual application of modern scientific, technical and technological processes of production and business increases the quality of activities at the University. Department of Fire Protection is at the Faculty of Wood Sciences and Technology.



UNIVERSITY
OF NOVI SAD



FACULTY OF
TECHNICAL
SCIENCES

The Faculty of Technical Sciences in Novi Sad is an institution of higher education and scientific research founded in 1960, whose mission is to realize high quality educational programme, develop scientific disciplines and apply the acquired knowledge in economy and society.

There are four disciplinary-related science and educational fields implemented by the FTS:

- engineering and technology,
- natural science and applied mathematics and
- human sciences and applied art.

Faculty consists of 13 departments implementing 88 study programme at the undergraduate and postgraduate levels.

The Department of Civil Engineering and Geodesy offers a comprehensive study programme in the field of civil engineering, survey (geodesy) and disaster and fire risk management: Disaster management and Fire Safety B.Sc. Honours and M.Sc. Qualification levels. Disaster Risk Reduction Centre established in 2007, has the mission to promote and contribute to the culture of resilience by dissemination of the latest research results of hazard, vulnerability and risk-related indicators.

PROGRAMME COMMITTEE

President:

Verica Milanko, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Members:

Branko Savić, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Danica Kačikova, Technical University, Zvolen, Slovakia

Đorđe Ladinović, Faculty of Technical Sciences, Novi Sad, Serbia

Eva Mračková, Technical University, Zvolen, Slovakia

Anton Oswald, Faculty of Special Engineering, Zilina, Slovakia

Dubravka Bjegović, Civil Engineering Faculty, Zagreb, Croatia

Ljubov Davidova, Sankt-Petersburg University, EMERCOM of State Fire, St. Petersburg, Russia

Meri Cvetkovska, Civil Engineering Faculty, Skopje, Macedonia

Dragan Karabasil, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Žarko Janković, Faculty of Occupational Safety, Niš, Serbia

Slobodan Krnjetin, Faculty of Technical Sciences, Novi Sad, Serbia

László Komjáthy, University of Defense, Budapest, Hungary

Jovan Vučinić, University of Applied Sciences, Karlovac, Croatia

Sergey Kondratyev, Sankt-Petersburg University, GPS MČS, St. Petersburg, Russia

Iveta Marková, Faculty of Natural Sciences, Banská Bystrica, Slovakia

Sulejman Meta, Faculty of Applied Sciences, State University of Tetovo, Macedonia

Predrag Ilić, JNU “Institute for protection and ecology of the Republic of Srpska”,

Banja Luka, Bosnia and Herzegovina

Vlastimir Radonjanin, Faculty of Technical Sciences, Novi Sad, Serbia

Mirjana Laban, Faculty of Technical Sciences, Novi Sad, Serbia

Anita Petrović Gegić, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Saša Spaić, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Borislav Simendić, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Branko Babić, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Dušan Gavanski, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Petra Tanović, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

ORGANIZING COMMITTEE:

President:

Branko Savić, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Vice-president:

Dragan Karabasil, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Danica Kačikova, Technical University, Zvolen, Slovakia

Đorđe Ladinović, Faculty of Technical Sciences, Novi Sad, Serbia

Members:

Tima Segedinac, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Slobodan Purić, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Branko Milisavljević, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Vesna Petrović, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Zvonimir Bukta, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Branka Petrović, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Nataša Subić, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Varvara Lazarević, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Vesna Marinković, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

Tatjana Božović, Higher Education Technical School of Professional Studies, Novi Sad, Serbia

PREFACE

The Higher Education Technical School of Professional Studies in Novi Sad, traditionally organizes scientific and professional conferences on the highest level in the country in the field of fire and explosion protection. We proudly emphasize our leading position in education when it comes to professions concerning fire protection.

In 1976, 1st Yugoslav conference of fire and explosion is held at the Faculty of Agriculture in Novi Sad. It gathers the most eminent experts in the field of fire of the former Yugoslavia. Then, there are two more conferences, also held in Novi Sad in 1984, at "SPENS", and in 1989 at the "Putnik" Hotel.

In 1994, when 4th Yugoslav and 1st International conference of fire and explosion is organized, this conference grows into an international meeting with the help of our colleagues and experts from Ukraine, Poland and Hungary. Since then, the conference is organized biannually, and in 2006, on its 10th anniversary, it grows into the congress of the profession.

In 2008 the conference is organized as an international scientific meeting prepared in cooperation with the Faculty of Technical Sciences from Novi Sad and the Technical University in Zvolen from the Slovak Republic, bringing together experts in the field of safety and protection from Serbia and abroad.

With the same team, 4th International scientific conference and 14th International conference on fire and explosion is organized this year at the Higher Education Technical School of Professional Studies in Novi Sad on 2nd and 3rd October 2014. The aim of the conference is the exchange of the latest scientific knowledge and experience of experts in the field of safety engineering, and the main topic of fire protection is complemented by topics in the field of environmental engineering, occupational health and safety, and civil protection.

In order to efficiently manage risk situations, it is necessary to identify conditions and hazards, study the causes of risk events and build a strategy for preventing their development and consequences.

Positive results can be expected by involving scientists and experts dealing with safety engineering and process management in the living and working environments. The exchange of opinions and knowledge is essential and one of the steps contributing to progress

Organizing committee

САДРЖАЈ:

БЕЗБЕДНОСТ ОД ПОЖАРА/FIRE SAFETY ENGINEERING

<i>Dubravka Bjegović, Ivana Banjad Pečur, Bojan Milovanović</i> ENERGY EFFICIENCY AND FIRE SAFETY OF HIGH-RISE BUILDINGS	1
<i>Meri Cvetkovska, Milivoje Milanović</i> FIRE RESISTANCE OF DIFFERENT TYPES OF SIMPLY SUPPORTED FLOOR STRUCTURES	12
<i>Marija Jelčić Rukavina, Dubravka Bjegović, Enes Seferović</i> INFLUENCE OF HIGH FIRE TEMPERATURES ON FIBRE REINFORCED CONCRETE	21
<i>Радинко Костић</i> ОТПОРНОСТ НА ДЕЈСТВО ПОЖАРА ПРЕГРАДНОГ "ПЛАСТБАУ" ЗИДА У РЕАЛНИМ УСЛОВИМА ИСПИТИВАЊА	29
<i>Rose Smileski, Verica Milanko, Zoran Neshkoski</i> FUNCTIONAL DEPENDENCE OF THE HAZARDS AND MEASURES FOR FIRE SAFETY IN CORRELATION WITH THE FIRE LOAD	40
<i>Ivana Banjad Pečur, Ivan Gabrijel, Bojan Milovanović, Ivana Carević</i> ISPITIVANJE NA POŽAR NOVOG INOVATIVNOG PREDGOTOVLJENOG FASADNOG ELEMENTA	46
<i>Slobodan Šupić, Suzana Vukoslavčević, Mirjana Laban</i> VULNERABILITY OF PRECAST INDUSTRIAL BUILDINGS EXPOSED TO FIRE	54
<i>Iveta Marková, Jozef Lauko,</i> TEST OF FIRE OF OIL PRODUCT BS95 - WATCHING THE SPEED OF BURNING	61
<i>Vladimir Mozer, Jozef Klucka</i> ESTABLISHING ECONOMIC IMPACT OF FIRE	74

Андреј Мокряк, Анна Мокряк

EXPERT ANALYSIS OF MOLTEN COPPER CONDUCTORS FORMED BY
OVERCURRENT 82

Eva Mračková

FIRE PROTECTION OF BUILDINGS FOR MOTOR VEHICLES WITH DRIVES
LPG, CNG AND LNG 92

Зоран Ловрековић, Драган Карабасил

КОМПЈУТЕРСКА ИГРА ЗА ВАТРОГАСЦЕ 103

Sergey Kondratyev, Anna Vorontsova, Natalia Petrova, Tatiana Kuzmina

APPLICATION OF INFORMATIVE TECHNOLOGIES AND CALCULATIVE
METHODS IN THE FORENSIC NORMATIVE EXPERTISE AND IN
PROFESSIONAL EDUCATION OF FORENSIC EXPERTS 110

Darko Jocić, Mirjana Laban

PRIMENA INFORMACIONIH SISTEMA ZA IZBOR OPTIMALNE PUTANJE
KRETANJA VATROGASNIH ЕКИПА DO MESTA AKCIDENTA 119

Слободан Крњетин, Олга Крњетин

АНАЛИЗА ПАРАМЕТАРА У МОДЕЛОВАЊУ ЕВАКУАЦИЈЕ ЉУДИ У
ПОЖАРУ 126

Биљана Гемовић, Наташа Субић

ПРИМЕНА CAD (COMPUTER AIDED DESIGN) АПЛИКАЦИЈА У
ОБРАЗОВАЊУ ЗАШТИТЕ ОД ПОЖАРА 134

Zsolt Noskó, Alexandra Kiss, László Komjáthy

ANDROID-BASED DECISION SUPPORT IN ACCIDENTS INVOLVING THE
TRANSPORTATION OF DANGEROUS GOODS 143

Драган Карабасил, Зоран Николић

ЕВАКУАЦИЈА ЉУДИ ИЗ ОБЈЕКТА ЗАХВАЋЕНИХ ПОЖАРОМ 148

J Frank D. Stolt

FIRE SAFETY AND INVESTIGATION OF FIRES IN BUSES 153

Татјана Божовић, Мирјана Лабан, Верица Миланко, Саша Богданов

МОГУЋНОСТ ПРИМЕНЕ ВОДЕНОГ СТАКЛА ЗА ЗАШТИТУ ДРВЕНИХ
КОНСТРУКЦИЈА У ПОЖАРУ 167

Jaroslav Flachbart, Vladimír Mózer, Anton Osvald

FIRE SAFETY SYSTEMS MINIMISE ECONOMIC LOSS 175

<i>Miroslava Vandlíčková</i>	
EFFICIENCY OF ACTIVE FIRE PROTECTION SYSTEMS	183
<i>Darko Nešković</i>	
IMPROVEMENT OF SYSTEM FOR FIRE PROTECTION IN FACILITIES WITH EXTREME WORK CONDITIONS WITH THERMAL IMAGING AND VIDEO SURVEILLANCE	189

<i>Радинко Костић</i>	
ТАКТИКА ГАШЕЊА ПОЖАРА МОТОРА ПУТНИЧКИХ ВАЗДУХОПЛОВА	198

<i>Nada Marstijepović, Velizar Čađenović</i>	
NAPON PARA I TAČKA PALJENJA KAO OSNOV ZA ODREĐIVANJE PREVENTIVNIH MERA ZAŠTITE OD POŽARA I EKSPLOZIJE ZAPALJIVIH TEČNOSTI	206

<i>Зоран Благојевић, Душица Пешић, Дарко Зигар</i>	
РЕКОНСТРУКЦИЈА СТАЦИОНАРНЕ ИНСТАЛАЦИЈЕ ЗА ГАШЕЊЕ ПОЖАРА УГЉЕН-ДИОКСИДОМ И ПРЕДНОСТИ НОВОГ УГРАЂЕНОГ СИСТЕМА У ХЕ "БЕРДАП 1"	212

<i>Ивана Пејачки, Мирјана Лабан</i>	
ДОБРОВОЉНА ВАТРОГАСНА ДРУШТВА У ВОЈВОДИНИ	218

<i>Љубица Крњачић</i>	
ДОБРОВОЉНО ВАТРОГАСТВО ШАНСА ДРЖАВЕ И ПОЈЕДИНЦА	225

ЦИВИЛНА ЗАШТИТА И СПАСАВАЊЕ У ВАНРЕДНИМ СИТУАЦИЈАМА CIVIL PROTECTION AND EMERGENCY RESCUE

<i>Dragutin Jovanović, Branko Babić, Dragan Babić</i>	
THE DEVELOPMENT OF CIVIL PROTECTION IN THE REPUBLIC OF SERBIA	235

<i>Alexander Matveev, Alexander Maximov, Andrey Perlin</i>	
THE RESOURCE POTENTIAL OF EMERCOM OF RUSSIA: CONCEPT AND PROSPECTS OF USE	242

<i>Драган Млађан, Предраг Марић, Ђорђе Бабић</i>	
ШТАБСКИ НАЧИН РУКОВОЂЕЊА У ЗАШТИТИ И СПАСАВАЊУ БЕЗБЕДНОСТ И ЗДРАВЉЕ НА РАДУ/ OCCUPATIONAL SAFETY AND HEALTH	245

<i>Мира Пуцаревић, Петра Тановић, Љиљана Ђурчић</i> ТЕШКИ МЕТАЛИ У СУСПЕНДОВАНИМ ЧЕСТИЦАМА ПРАШИНЕ У ШТАМПАРИЈАМА	257
<i>Весна Петровић, Борислав Симендић, Весна Маринковић</i> ДЕКОМПОЗИЦИЈА АЗБЕСНО ЦЕМЕНТНИХ КРОВНИХ ПЛОЧА ПРИ ТЕРМИЧКОМ ТРЕТМАНУ	264
<i>Жарко Јанковић, Срђан Глишовић</i> СМАЊЕЊЕ РИЗИКА ПРИ ПРОЈЕКТОВАЊУ ОПРЕМЕ ЗА РАД	273
<i>Божо Илић, Бранко Савић</i> ЗАШТИТА ОД СТРУЈНИХ УДАРА УЗРОКОВАНИХ ЛУТАЈУЋИМ СТРУЈАМА	281
<i>Zoran Vučinić, Nenad Mustapić, Jovan Vučinić</i> UTJECAJ NOĆNOG RADA NA RADNIKA	289
<i>Michal Belcik, Karol Balog, Zuzana Szabova, Pavol Cekan, Richard Kuracina</i> FACTORS AFFECTING HUMAN PERFORMANCE AND METHOD OF THEIR APPLICATION IN HUMAN RELIABILITY ASSESSMENT	297
<i>Nenad Mustapić, Zoran Vučinić, Igor Burić</i> ZAŠTITA OD BUKE U POSTROJENJIMA TVORNICE MINERALNIH GNOJIVA	304
<i>Јован Перовић, Смиља Матић</i> ОПАСНОСТИ И (НЕ)БЕЗБЕДНОСТ ПОЛИЦИЈСКИХ СЛУЖБЕНИКА	312
<i>Звонимир Букта, Цвијо Шмања</i> ПОВЕЋАЊЕ БЕЗБЕДНОСТИ НА РАДУ ПРИМЕНОМ БЕЗБЕДНОСНИХ МЕТОДА РАДА	320
<i>Душан Гавански</i> БЕЗБЕДАН РАД НА РАВНАЛИЦИ	326
<i>Dario Bognolo, Mensur Ferhatović, Mladen Ščulac</i> OUTSOURCING U VATROGASTVU	334

РИЗИЦИ ОД КАТАСТРОФАЛНИХ ПОЖАРА/ DISASTER RISK ASSESSMENT

Борко Ђ. Булајић, Миодраг И. Манић, Ђорђе Лађеновић
ON THE APPLICATION OF uniform hazard spectra IN EARTHQUAKE
ENGINEERING 341

Владимир М. Цветковић, Бојан Јанковић, Божидар Бановић
ГЕОПРОСТОРНА И ВРЕМЕНСКА ДИСТРИБУЦИЈА ЦУНАМИЈА КАО
ПРИРОДНИХ КАТАСТРОФА 352

Душан Врањеш
СТАЊЕ И МЈЕРЕ ЗАШТИТЕ ОД ПОПЛАВА НА ПОДРУЧЈУ ГРАДА
ПРИЈЕДОРА 361

Зоран Благојевић, Станимир Живановић, Дејан Крстић, Дарко Зигар
АНАЛИЗА ВЕТРА НА ПОДРУЧЈУ НЕГОТИНА СА АСПЕКТА
УГРОЖЕНОСТИ ШУМА ОД ПОЖАРА 372

Александар Бабић, Предраг Илић
ЗНАЧАЈ И УЛОГА ПЛАНА ЗАШТИТЕ И СПАСАВАЊА ОД
ЕЛЕМЕНТАРНЕ НЕПОГОДЕ И ДРУГЕ НЕСРЕЋЕ 382

Душан Врањеш
ПРОЦЕНА УГРОЖЕНОСТИ ОД ПОЖАРА ПОДРУЧЈА ГРАДА ПРИЈЕДОРА
ПО МОДЕЛУ РИЗИКО БАЗИРАНОГ ДИМЕНЗИОНИРАЊА 388

Горан Ђорђевић, Михајило Раткнић, Соња Бранковић, Милан Петровић
КОНЦЕПТ ИЗРАДЕ ПЛАНОВА ЗАШТИТЕ ШУМА ОД ПОЖАРА -
ПРЕДЛОГ ДОПУНЕ ПОСТОЈЕЋЕГ ПРАВИЛНИКА ЗА ИЗРАДУ ПЛАНОВА
ЗАШТИТЕ ОД ПОЖАРА 397

ЗАШТИТА ЖИВОТНЕ СРЕДИНЕ/ ENVIRONMENTAL PROTECTION

Biljana Škrbić, Vesna Marinković, Verica Milanko, Saša Spaić, Ana Senderak
BENZENE IN COMBUSTION PRODUCTS AND THERMAL
DECOMPOSITION PRODUCTS OF POPLAR WOOD SAWDUST 411

Peter Rantuch, Karol Balog, Jozef Martinka
DETERMINATION OF ACTIVATION ENERGY VIA CONCENTRATION OF
CARBON MONOXIDE IN COMBUSTION GASSES 420

Петра Балабан
ЕКОЛОШКО ВРЕДНОВАЊЕ ГРАФИЧКЕ АМБАЛАЖЕ 432

Иван Ђуковић
ГАШЕЊА ПОЖАРА ЕКОЛОШКИМ СРЕДСТВИМА 441

Љиљана Лучић
СЕДМИ ОПШТИ ЕКОЛОШКИ АКЦИОНИ ПРОГРАМ ЕУ: ЖИВЕТИ ДОБРО
УНУТАР ОГРАНИЧЕЊА КОЈЕ ПОСТАВЉА НАША ПЛАНЕТА И
ОЗЕЛЕЊАВАЊЕ ПРИВРЕДЕ И ЗАПОШЉАВАЊА 449

Иван Билић
УВОЂЕЊЕ УПРАВЉАЊА ЗЕЛЕНОМ УЧИОНИЦОМ У РАДНО
ОКРУЖЕЊЕ 459

Петра Тановић, Дуња Мандић
СВЕСТ ЗАПОСЛЕНИХ У ШТАМПАРИЈАМА У ПОГЛЕДУ ОЧУВАЊА
ЖИВОТНЕ СРЕДИНЕ 469

Anđelina Kuzmanović, Goran Prolić
ENERGETSKI EFIKASNA REŠENJA U SISTEMU RAVNIH I KOSIH
KROVOVA SA POSEBNIM OSVRTOM NA ZAŠTITU OD POŽARA 476

ЛЕГИСЛАТИВА ИЗ ОБЛАСТИ ЗАШТИТЕ/ SAFETY LEGISLATION

Славиша Богуновић
ТЕХНИЧКА РЕГУЛАТИВА У ОБЛАСТИ БЕЗБЕДНОСТИ ОД ПОЖАРА
ФАСАДНИХ ЗИДОВА 489

ОБРАЗОВАЊЕ У ОБЛАСТИ ИНЖЕЊЕРСТВА ЗАШТИТЕ И БЕЗБЕДНОСТИ/ SAFETY ENGINEERING EDUCATION

Милан Срдановић, Љубица Крњић, Верица Миланко
ЕДУКАЦИЈЕ ИЗ ОБЛАСТИ ЗАШТИТЕ ОД ПОЖАРА УЧЕНИКА У
СРЕДЊИМ ШКОЛАМА 499

Маријола Божовић
ВАСПИТНО ОБРАЗОВНА И ИНФОРМАТИВНА ДЕЛАТНОСТ У
ФУНКЦИЈИ ЗАШТИТЕ И БЕЗБЕДНОСТИ 507

ИСКУСТВА ИЗ ПРАКСЕ/ EXPERIENCES FROM PRACTICE

Бранко Ђукић, Драган Карабасил, Славко Смиљанић

ПЕНИЛА ЗА ГАШЕЊЕ ПОЖАРА, КВАЛИТЕТ, ПРИМЕНА
И ПОТРОШЊА

517

Радован Јованов

НУЖНОСТ ОДОБРЕЊА ЛОКАЦИЈЕ ЗА ИЗГРАДЊУ ОБЈЕКТА ЗА
СМЕШТАЈ ОСАМ БОЦА ОД ПО 35 kg. ТНГ-А

525

*Међународна научна конференција
Безбедносни инжењеринг*



Нови Сад, 2-3. октобар, 2014.

БЕЗБЕДНОСТ ОД ПОЖАРА

*International Scientific Conference
on Safety Engineering*



Novi Sad, October 2-3, 2014.

FIRE SAFETY ENGINEERING

За садржај радова и квалитет језика одговорни су сами аутори.

The authors themselves are responsible for the content and language quality of the papers.

Miroslava VANDLÍČKOVÁ¹

Review paper

EFFICIENCY OF ACTIVE FIRE PROTECTION SYSTEMS

Abstract: Nowadays fire protection systems represent an integral part of fire prevention measures. We live in a society in which building of large undivided spaces, that represent a risk of heavy losses in case of fire, are typical. In order to prevent such large fires right the protection systems serve that on the basis of its functionality are divided into passive and active ones. Active fire protection systems may, without direct intervention of device maintainance, affect the development of fire, its sedation or disposal [12]. The article deals exactly with this group of fire protection systems, and attention is paid especially to their reliability and efficiency.

Key words: fire, fire protection systems, prevention, active fire protection, reliability, efficiency

ЕФИКАСНОСТ АКТИВНИХ СИСТЕМА ЗАШТИТЕ ОД ПОЖАРА

Резиме: Данас системи заштите од пожара представљају саставни део мера за превенцију од пожара. Живимо у друштву у којем су типичне зграде са великим неподељеним просторима, који представљају ризик од огромних губитака у случају пожара. Баш у циљу спречавања тако великих пожара користе се системи заштите који се на основу своје функционалности деле на пасивне и активне. Активни системи заштите од пожара могу, без директне интервенције на одржавање уређаја, утицати на развој пожара, његово смиривање или гашење [12]. Раду се бави управо овом групом система заштите од пожара, а посебна пажња је посвећена њиховој поузданости и ефикасности.

Кључне речи: пожар, системи за заштиту од пожара, превенција, активна заштита од пожара, поузданост, ефикасност

¹ Ing., Ph.D., University of Žilina, Faculty of Security Engineering, Street of the 1.st May 32, 010 26 Žilina, Slovak Republic, Miroslava.Vandlickova@fbi.uniza.sk

1. INTRODUCTION

The main task of fire protection systems is to efficiently liquidate a fire in-cooperation with forces of Fire and Rescue Services. Fire-protection systems are fire extinguishers, stable and semi-stable fire extinguishing devices, smoke and heat exhaust ventilation systems, fire detection systems, spark extinguishing systems in pneumatic conveyors and antiexplosion elements and fire closures. [1] Generally spoken, the fire-protection systems help in identifying the particular fire area, reducing the time since the beginning of the fire till its announcement, drawing off smoke and heat from the fire area, tracking and putting fire under control and they allow management of evacuation. [11] Fire protection systems are divided into active and passive fire protection systems. Active fire protection systems such as water sprinkler and spray systems are widely used in the process industries for protection of storage vessels, process plant, loading installations and warehouses. Other more specialised systems using inert gases and halogen based gases are used for flooding enclosed spaces. Passive fire protection can provide an effective alternative to active systems for protecting against vessel failure. The following factors should be considered in determining which kind of active and passive fire protection systems are required – fire hazard posed by substance, toxicity of substances and the smoke produced, inventory size, frequency of hazardous operations, available access to fight fire, fire fighting capability of on site emergency response team, response time of the nearest fire brigade, resources available to fire brigade. [5].

2. FIRE PROTECTION SYSTEMS

2.1.Active fire protection systems

Active fire protection systems protects buildings against fire in such way that they use the action of moving parts. These systems can be automatic or manual but they require some sort of action (e.g. based on smoke noticing) in order to work. Examples of active fire protection can be fire alarm systems, sprinkler systems, etc. Vice versa passive fire protection uses objects that slow fire (e.g. fire walls, fire doors, fire retardant materials, etc.), but take no action in the process of fire fighting.

2.2.Basic division of active fire protection systems

Fire alarms

Fire alarms include electric equipments that work through visual and audio appliances by detecting smoke at fire. Fire alarms tends to activate first giving the opportunity to evacuate. Most fire alarm systems consist of a fire alarm control panel, a primary power supply, a secondary (backup) power supply, initiating devices that can be manual (pull stations) or automatic (smoke detectors), notification appliances (flashing lights, horns, etc.), building safety interfaces (ventilation systems, etc.).

Fire alarm effectiveness can be hampered by the choice of inappropriate alarms for the environmental conditions expected, which can cause nuisance activation and ignorance of a real fire event. The second barrier to effectiveness can be human behavior - the tendency of



people to ignore the alarm, to decide that the horns and strobes activating are “not the real thing,” and to delay evacuation of the building. [8]

Fire sprinklers

Fire sprinkler systems are the most common form of active fire control and suppression. The simplest and fastest method of control are wet pipe sprinkler systems filled with water while dry pipe sprinkler systems have pipes filled with compressed air or nitrogen gas, which holds the clapper on a dry pipe valve in the closed position. Foam sprinkler systems use foam to extinguish fires in buildings. The fire sprinkler pump distributes the water and foam mixture via the pipe-system and discharges the foam spray via the sprinklers. [13]



Figure 1 Foam sprinkler system [3]

Hand held extinguishers

Hand held extinguishers are devices used to extinguish or control small fires, often in emergency situations. A fire extinguisher consists of a hand held cylindrical pressure vessel that contains an agent which is discharged to extinguish a fire. According to extinguishing substance hand held extinguishers can be described as water, foam, halon, powder CO₂ extinguishers. [6]

Smoke and heat exhaust ventilation systems

Smoke and heat exhaust ventilation systems constitute an essential part of preventive fire protection. Smoke and heat exhaust ventilation systems ensure the reliable and automatic opening of exhaust apertures. They minimise the development of smoke in escape and rescue routes, thus protecting people from smoke intoxication and property from damage. [7]

Spark extinguishing systems in pneumatic conveyors

Spark detection systems are primarily used as a fire prevention method in dust collectors, mechanical and pneumatic conveying systems by detecting and extinguishing sparks and embers. [4]

3. EFFICIENCY OF FIRE PROTECTION SYSTEMS

Many relevant information and results that are carried out in the area of determining the effectiveness of fire protection systems are not published in books or major scientific

periodicals. The reason is that such results remain mostly recorded only in laboratory reports and internal sources of information, which do not often find way to general data bases. Therefore, more comprehensive studies that deal with the effectiveness of fire protection systems are still of a limited number.

Watanabe uses for the systems three different probability concepts:

Reliability - probability of performing the specified function under specified conditions for a specified time without failure

Capability – probability of achieving the operational demand under specified conditions satisfactorily

Availability – probability of operating satisfactorily at any given time under specified conditions

The effectiveness of the system is the product of these three factors. [2] Based on several international studies (Warrington Fire Research Study in the UK, The Australian Fire Engineering Guidelines in Australia, a compilation of fire statistics for Tokyo in Japan and results of a study "in situ" of fire protection systems in Japan by Watanabe), discussing the reliability of estimates of detection systems and fire suppression as well as the design division of space in terms of fire safety, might be mentioned the following data given in the following table 1.

Table 1 Published estimates for active fire protection systems operational reliability [%] [9]

Protection System	Warrington Delphi UK (Delphi Group)		Fire Eng Guidelines Australia (Expert Survey)		Japanese Studies (Incident Data)	
	Smoldering	Flaming	Smoldering	Flaming/flash over	Tokyo FD	Watanabe
Heat detector	0	89	0	90/95	94	89
Home smoke alarm	76	79	65	75/74	N	N
System smoke detector	86	90	70	80/85	94	89
Beam smoke detectors	86	88	70	80/85	94	89
Aspirated smoke det.	86	N	90	95/95	N	N
Sprinklers operate	95		50	95/99	97	N
Sprinklers control but do not extinguish	64		N		N	N
Sprinklers extinguish	48		N		96	N

Wherever possible, the data used should be directly applicable to the case under consideration. For example shopping malls and airports collate data on the time it takes to evacuate the building when the fire alarm goes off. Such data are unlikely to be released into the public domain, but might be available when a study on the development in question is carried out. In the following table 2 there are some data of reliability of automatic fire detection and alarm systems (AFDA), sprinkler systems and smoke control systems.

Table 2 Reliability data [10]

Fire alarm and detection systems		
Improvement in probability of early detection in buildings with AFDA	General value	0,5 to 0,6
Reliability of alarm box, wiring and sounders	General value	0,95 to 1
Reliability of detectors	Commercial smoke	0,9
	Domestic smoke	0,75
	Aspirating smoke	0,9
	Heat	0,9
	Flame	0,5
Automatic fire suppression systems		
Overall reduction in loss due to provision of sprinklers	General value	50%
Probability of successful sprinkler operation	Maximum	0,95
	General:	-
	Property protection	0,9
	Life safety	0,8
	Minimum	0,75
Probability of successful operation for other AFS systems	General value	0,9
Smoke control systems		
Probability of system operating as designed, on demand	General value	0,9

4. CONCLUSION

Fire protection systems meet today its irreplaceable role in such emergencies, such as fires of particular objects. In modern little divided area of shopping malls, large manufactural halls or open - space offices there are suitable conditions for the rapid spread of the fire into the entire space of the buildings. In order to eliminate production of huge property damage, injuries or losses of lives it is necessary to instal the fire protection systems in the buildings. These, of course, have to work with the efficiency as high as possible in order that rescue of human health, lives and property exceed the financial costs of the purchasing and installing of the fire protection systems in buildings and thus motivate all subjects to their installation. As shown by some foreign studies, the effectiveness of different kinds of fire protection systems are varied in particular intervals and to their reliable operation contribute, of course, various factors. Efficiency area of fire protection systems is more complex issue and involves the cooperation of many practitioners, as well as the fire protection systems producers themselves.

5. REFERENCES

- [1] BUKOWSKI, R. at all: Estimates of the Operational Reliability of Fire Protection Systems. *Fire Protection Strategies for 21st Century Building and Fire Codes*

- Symposium. Society of Fire Protection Engineers and American Institute of Architects. September 17-18, 2002, Baltimore, MD, s. 111-124*
- [2] FLACHBART, J.: Vplyv požiaro-technických zariadení na bezpečnosť osôb v stavbe. 1. ročník medzinárodnej konferencie *Bezpečnosť práce v záchranných službách*. Štrbské Pleso, Vysoké Tatry, 27. – 29. apríl 2014
- [3] NYYSSÖNEN, T. at all.: On the reliability of fire detection and alarm systems. *Exploration and analysis of data from nuclear and non-nuclear installations*. VTT Technical Research Centre of Finland. 2005. S. 21 – 26. ISBN 951-38-6569-X. 62 s.
- [4] ROACH, K.: *Balancing passive, active fire protection*. The International Building Code and NFPA standards provide guidance on passive and active fire protection systems. [Online] [July, 4th, 2014]. Available at: <http://www.csemag.com/single-article/balancing-passive-active-fire-protection/6201f8f2c81dd5cd87307b7e0075161d.html>
- [5] VANDLÍČKOVÁ, M.: Účinnosť požiaro-technických zariadení. *The 23rd International Conference on FIRE PROTECTION 2014*. VŠB - Technical University of Ostrava
- [6] *Application of fire safety engineering principles to the design of buildings – Probabilistic risk assessment*. British Standards. PD 7974-7:2003. ISBN 0580 415155
- [7] Požiaro-technické zariadenia. 2013. [Online] [July, 8th, 2014]. Available at http://www.bezpeteam.sk/bozp-a-po-/poziarno-technicke-zariadenia-/?utm_source=copy&utm_medium=paste&utm_campaign=copypaste&utm_content=html%3A%2F%2Fwww.bezpeteam.sk%2Fbozp-a-po-%2Fpoziarno-technicke-zariadenia-%2F
- [8] Foam sprinkler systems. [Online] [July, 8th, 2014]. Available at <https://www.protec.co.uk/product-page/sprinklers-and-water-mist/product/product/foam-sprinkler-systems/>
- [9] Foam sprinkler systems. [Online] [August, 5th, 2014]. Available at <http://www.grundfos.com/service-support/encyclopedia-search/foam-sprinkler-systems.html>
- [10] Health and Safety Executive: Active/passive fire protection. [Online] [August, 8th, 2014] Available at <http://www.hse.gov.uk/comah/sragtech/techmeasfire.htm>
- [11] Sloval law n. 314/2001 Z.z. o ochrane pred požiarimi v znení neskorších predpisov [Online] [August, 26th, 2014]. Available at http://www.minv.sk/swift_data/source/hasici_a_zachranari/malatinec_opp/vseobecne_zavazne_predpisy/2009/314%20uplne%20znenie.pdf
- [12] Smoke and heat exhaust ventilation systems (RWA). [Online] [August, 26th, 2014] Available at <http://www.g-u.com/en/window-technology/rwa-shev-and-everyday-ventilation-systems/rwa.html>
- [13] Spark detection and extinguishing systems. Online] [August, 26th, 2014]. Available at <http://www.grecon-us.com/spark-detection/>

CIP - Каталогизација у публикацији
Библиотека Матице српске, Нови Сад

614.8(082)
351.78(082)
502/504(082)
331.45(082)
62-78(082)

МЕЂУНАРОДНА научна конференција Безбедносни инжењеринг (4 ; 2014 ; Нови Сад)

Зборник радова = Proceedings / 4. међународна научна конференција Безбедносни инжењеринг и 14. међународна конференција Заштите од пожара и експлозије, Нови Сад, 02-03. октобар 2014 = 4rd International Scientific Conference on Safety Engineering and 14th International Conference [on] Fire and Explosion Protection, Novi Sad, October 02-03, 2014. - Нови Сад : Висока техничка школа струковних студија, 2014 (Нови Сад : ВТШСС). - 600 стр. : илустр. ; 25 cm

Радови на срп. и енгл. језику. - Тираж 150. - Резимеи на

срп. или енгл. језику уз сваки рад. - Библиографија уз сваки рад.

ISBN 978-86-6211-095-4

1. Међународна конференција заштите од пожара и експлозије (14 ; 2014 ; Нови Сад)

a) Заштита од пожара - Зборници b) Заштита од експлозије - Зборници c) Цивилна заштита - Зборници d) Животна средина - Заштита - Зборници e) Заштита на раду - Зборници
COBISS.SR-ID 289885191



ВИСОКА ТЕХНИЧКА ШКОЛА
СТРУКОВНИХ СТУДИЈА