ВИСОКА ТЕХНИЧКА ШКОЛА СТРУКОВНИХ СТУДИЈА

ФАКУЛТЕТ ТЕХНИЧКИХ НАУКА НОВИ САД

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

ЗОП 2014

НОВИ САД, 2-3. ОКТОБАР 2014.

ЗБОРНИК РАДОВА
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SAFETY ENGINEERING

FIRE, ENVIRONMENT,
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FIRE AND EXPLOSION PROTECTION

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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
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НОВИ САД, РЕПУБЛИКА СРБИЈА

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SAFETY ENGINEERING

FIRE, ENVIRONMENT, WORK ENVIRONMENT, INTEGRATED RISK

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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.

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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

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

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За садржај радова и квалитет језика одговорни су сами аутори.

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Miroslava VANDLÍČKOVÁ[1] *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

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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 CO_2 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 cinditions satisfacorily

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 1Published 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 2Reliability 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 Domestic smoke Aspirating smoke Heat Flame	0,9 0,75 0,9 0,9 0,5
Automatic fire suppression systems		
Overall reduction in loss due to provision of sprinklers	General value	50%
Probability of successful sprinkler operation	Maximum General: Property protection Life safety Minimum	0,95 - 0,9 0,8 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.

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