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Józefów



REPORT

from the 6th edition of
the conference

SAFETY OF NEW TECHNOLOGIES



CNBOP-PIB



- enhancing rescue technologies
- solutions for fire and civil protection



Report from the 6th International Conference “Safety of New Technologies”

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General information

Event name: 6th International Scientific Conference “Safety of New Technologies”

Date: 31 March – 1 April 2026

Organizer: CNBOP-PIB (in cooperation with the scientific community, the State Fire Service, and the fire protection industry)

Co-organizers:

The Main School of Fire Service (SGSP) / Fire University
WSB University in Dąbrowa Górnicza
Polish Naval Academy
Polish Air Force University in Dęblin
University of Applied Sciences WSGE named after Alcide De Gasperi in Józefów
Institut für Feuerwehr- und Rettungstechnologie (IFR), Dortmund Fire Service
Radom University
District Headquarters of the State Fire Service in Otwock
Municipal Headquarters of the State Fire Service in Kraków
School of Aspirants of the State Fire Service in Poznań
PZU LAB S.A.
European Fire Safety Alliance
Polish Association of Fire Protection and Rescue Equipment Manufacturers
Polish Pump Systems Manufacturers Association
Polish New Mobility Association
Polish Energy Storage Association
Polish Chamber of Energy Storage and Electromobility (PIME)
Association of Fire Protection Engineers and Technicians
Social Security Institute of the “Social Observatory” Foundation

Scientific Committee:

Chair of the Scientific Committee: sen. brig. Jacek Zboina, D.Sc. Eng.

Anna Rabajczyk, Prof., D.Sc.
Robert Socha, Prof., D.Sc.
Bernard Wiśniewski, Prof., D.Sc.
Wojciech Żurowski, Prof., D.Sc. Eng.
Aleksander Babiński, insp., D.Sc., Prof. of the Police Academy in Szczytno
Andrzej Czupryński, D.Sc., Prof. of WSB University
Paweł Lubiewski, D.Sc., Prof. of WSB University
Stanisław Rysz, D.Sc., Eng., Prof. of the University (Jan Grodek State University in Sanok)
Tomasz Safjański, D.Sc., Prof. of WSB University
Maria Zielecka, D.Sc., Prof. of the Institute (CNBOP-PIB)
Andrzej Krzyszkowski, D.Sc., Eng., Prof. of Radom University
Jarosław Struniawski, D.Sc.
Tomasz Klimczak, gen. brig., Ph.D., Prof. of the University (Fire University)
Paweł Janik, sen. brig., D.Sc. Eng.

Jacek Roguski, Ph.D. Eng., Prof. of the Institute (CNBOP-PIB)
Arkadiusz Kielin, brig., Ph.D. Eng.
Adam Rurak, Col. (ret.), Ph.D., M.Sc. Eng. (Polish Air Force University)
Mariusz Feltynowski, gen. brig. (ret.), Ph.D. Eng.
Michał Chmiel, Ph.D. Eng.
Dariusz Gołębiowski, Ph.D. Eng.
Bogusław Kogut, Ph.D. Eng.
Zenon Małkowski, Ph.D. Eng.
Tomasz Popielarczyk, Ph.D. Eng.
Sylvia Pratzler-Wanczura, Ph.D. Eng.
Jarosław Tępiński, Ph.D. Eng.
Jan Ziobro, Ph.D., M.Sc. Eng. (Jan Grodek State University in Sanok)
Rafał Kochańczyk, dep. insp., Ph.D. (National Police Headquarters)
Artur Szela, Ph.D.
Monika Wyszomirska, Ph.D.
Marcin Łapicz, jr brig., Ph.D. Eng. (Fire University)
Krzysztof Biskup, brig. (ret.), M.Sc. Eng.
Michał Gigoła, brig., M.Sc. Eng.
Daniel Małozieć, brig., M.Sc. Eng.
Andrzej Zajączkowski, brig., M.Sc. Eng.
Barbara Adamska, M.Sc.
Zbigniew Kaliszyk
Krzysztof Dąbrowski
Krzysztof Kochanowski
Maciej Mazur
Krzysztof Hałupka

Exhibitors:

Ambient System
Bosch
Digitex
Edufire
FireMax
Gras
Kadimex
Neuron
Nevotec
Polon-Alfa
Dexwal
Rosenbauer

Patron: Commander-in-Chief of the State Fire Service of Poland

Venue: CNBOP-PIB headquarters in Józefów

Format: Hybrid (on-site + online)

Purpose and nature of the conference: The aim of the BNT conference series is to advance knowledge on new technologies in safety. It serves as a platform for presenting research results, exchanging knowledge, and reviewing current technological trends.

Core pillars to date:

- safety of new technologies
- improvement of rescue technologies

Additionally in the 6th edition:

- technical solutions for civil protection
- application of technologies in rescue operations and public safety

Target audience:

- manufacturers, designers, installers
- officers and employees of the State Fire Service
- fire protection experts
- facility managers and owners
- risk engineers, insurance brokers
- other technical professionals

Conference agenda:

Day 1 – 31 March 2026

- SESSION 1: SOLUTIONS FOR CIVIL PROTECTION
Moderator: sen. brig. Jacek Zboina, D.Sc., Eng., CNBOP-PIB
Part 1: Protective structures and their equipment
Part 2: Effective civil protection based on new technical and technological solutions
- SESSION 2: SOLUTIONS FOR FIRE PROTECTION AND CIVIL PROTECTION
Moderator: Prof. Anna Rabajczyk, D.Sc., CNBOP-PIB

Day 2 – 1 April 2026

- SESSION 3: NEW TECHNOLOGIES AND THEIR SAFETY
Moderator: sen. brig. Paweł Janik, D.Sc., Eng., CNBOP-PIB
- SESSION 4: IMPROVEMENT OF RESCUE TECHNOLOGIES – solutions for rescue operations
Moderator: Michał Chmiel, Ph.D., Eng., CNBOP-PIB

Opening of the Conference

The conference was opened by sen. brig. Paweł Janik, D.Sc. Eng. After welcoming the assembled guests, he gave the floor to sen. brig. Jacek Zboina, D.Sc. Eng., Deputy Director of CNBOP-PIB for Certification and Approvals, who presented the planned agenda of the event.

The Director emphasized the tradition of the BNT conference series and its main thematic focus, involving new technologies in the context of their safety and their potential applications in rescue operations, prevention, and civil protection.

Introductory Remarks

Next, gen. brig. Grzegorz Szyszko, Ph.D. Eng., Deputy Commander-in-Chief of the State Fire Service, who assumed honorary patronage over the 6th edition of the BNT conference, took the floor.

Gen. brig. Szyszko presented a broad perspective on contemporary challenges in the field of safety, pointing to key areas where new technologies play a crucial role. He highlighted their application in incident scene reconnaissance, efficient transport organization, firefighting operations, as well as in civil protection and civil defense.

In his speech, he also referred to the new warning and alarm system, which will constitute an important element in enhancing public safety. He mentioned the need to invest in the development of protective structures such as shelters and hideouts, and emphasized the importance of technologies including filtration systems, power supply, communication, and environmental monitoring.

The Commander stressed the importance of effective crisis management based on modern digital tools. He devoted particular attention to currently developed solutions aimed at improving firefighter safety, including systems for monitoring vital parameters and firefighter location. He also mentioned ongoing work on intelligent personal protective equipment designed to better safeguard the health and lives of personnel.

He emphasized the importance of developing integrated, real-time digital decision-support systems that can significantly enhance operational effectiveness. He also highlighted the development of new vehicles and communication systems, as well as the growing role of modern training methods such as virtual environments and simulators.

In conclusion, gen. brig. Szyszko stressed that technology should primarily support firefighters and enhance their safety during operations. In this context, he underlined the key role of CNBOP-PIB as a center where new technologies are tested, developed, and verified in terms of their usefulness in rescue operations, and above all, safety.

Conference awards

The next item on the agenda was the presentation of ceremonial awards. The statuettes were awarded to:

1. In the category of fruitful cooperation with CNBOP-PIB:

- Sylvia Pratzler-Wanczura, Ph.D., M.Sc. Eng. – in recognition of the Institute for Fire and Rescue Technology, a scientific unit of the Dortmund Fire Service.
- gen. brig. Tomasz Klimczak, Ph.D., M.Sc. Eng., Prof. of the University – for cooperation with the Institute as Rector of the Fire University and Chair of the Scientific Council of CNBOP-PIB.

2. In the category of contribution to the development of the scientific journal “Safety & Fire Technology”:

- brig. (ret.) Tomasz Krasowski, M.Sc. Eng. – for authorship of publications dedicated to firefighter safety.
- Prof. Maria Zielecka, D.Sc. – for active editorial and advisory work and invaluable contribution to the scientific development of the journal.

3. Special distinction:

- sen. brig. (ret.) Jan Kielin, M.Sc. Eng. – for 60 years of service to fire protection.

Announcement of BNT VII

“Polish New Mobility Association – New Mobility Congress 2026 and announcement of BNT VII” – Albert Kania, PSNM

Mr. Albert Kania announced that the next edition of the BNT conference will take place in September this year in Katowice, as part of the New Mobility Congress.

In his speech, he presented the existing cooperation between CNBOP-PIB and PSNM, including the joint development of guidelines on fire safety in garages intended for charging electric and plug-in hybrid vehicles. He also mentioned the organization of a nationwide training session for uniformed services during last year’s edition of the congress, attended by approximately 300 officers.

Mr. Kania also presented statistics from the previous edition of the New Mobility Congress and forecasts related to this year’s event. He emphasized that its program will be based on eight key thematic pillars:

- 1) new mobility – electric, autonomous, shared, and sustainable,
- 2) cities of the future – accessible, health-oriented, and resilient,
- 3) Poland’s economic development through strategic investments and new technologies,
- 4) new energy for new mobility,
- 5) the New Mobility Social Contract,
- 6) defense and resilience – technological sovereignty as the foundation of security,
- 7) new architecture and low-emission construction in the era of transformation,
- 8) research and development for transformation.

1. Session 1: SOLUTIONS FOR CIVIL PROTECTION

1.1. Part 1: Protective structures and their equipment

“Regulation of the Ministry of the Interior and Administration on technical requirements for protective structures – overview of requirements” – sen. brig. Rafał Szczypta, M.Sc. Eng., National Headquarters of the State Fire Service

Session 1, moderated by sen. brig. Jacek Zboina, D.Sc. Eng., Deputy Director of CNBOP-PIB, was opened with a lecture by sen. brig. Rafał Szczypta, M.Sc. Eng. – Deputy Director of the Risk Forecasting Office of the National Headquarters of the State Fire Service and co-author of the regulation concerning shelter solutions.

In his presentation entitled the speaker introduced participants to the types of collective protection facilities, namely shelters and temporary refuge facilities, and characterized them in terms of their functions and key technical requirements.

He emphasized the necessity of designing protective structures with fire safety requirements in mind – both in terms of reducing the risk of fire occurrence and ensuring appropriate conditions in the event of a fire. He explained that it is essential to maintain structural load-bearing capacity, limit the spread of fire and smoke, ensure safe evacuation, and provide access for rescue teams.

Regarding structural requirements, sen. brig. Rafał Szczypta noted that designers may take into account the dynamic properties of construction materials, using the dynamic increase factor in their designs.

He stressed that a protective structure constitutes a separate fire compartment and must therefore meet specific technical requirements. He discussed issues related to fire separation elements, safeguards preventing the penetration of smoke and fire gases, evacuation exits leading to open space, and emergency exits.

The speaker also presented requirements concerning airtightness systems, air filtration and ventilation systems and power supply and refuge facilities, heating, and utility installations in shelters. He also highlighted issues related to accessibility and rules of use, as well as the need to ensure water supply for drinking and domestic purposes.

With regard to new technologies used as backup power sources, he mentioned, among others, energy storage systems, photovoltaic installations, and small wind turbines.

He also discussed requirements concerning equipment, including devices for detecting and measuring carbon monoxide and carbon dioxide concentrations, systems for receiving hazard alerts, and other monitoring and measurement devices. Finally, the speaker emphasized the importance of integrating fiber-optic installations in shelters to ensure communication in crisis situations and continuity of ICT systems.

The presentation leads to the conclusion that the contemporary approach to designing protective structures is based on integrating legal requirements with scientific knowledge, engineering practice, and innovative technological solutions, resulting in a higher level of safety and reliability of these facilities.

1.1.1. Discussion panel 1: “How to effectively and efficiently design, construct, modernize, and adapt protective structures”

The panel was attended by: **gen. brig. Tomasz Klimczak, Ph.D. Eng.;** **sen. brig. Rafał Szczypta, M.Sc. Eng.;** **sen. brig. Paweł Janik, D.Sc. Eng.;** **Zenon Małkowski, Ph.D. Eng.;** **attorney-at-law Barbara Puzkarewicz;** and **sen. brig. (ret.) Mariusz Zabrocki, M.Sc. Eng.**

Gen. brig. Tomasz Klimczak, Ph.D. Eng., Prof. of the University, presented the perspective of the Fire University, focusing on tasks related to personnel training and the implementation of new solutions at the national level. He emphasized that the activities undertaken are long-term in nature and are already yielding initial results, with the necessary funding secured. He highlighted a key challenge: building societal resilience through public education. In this context, he pointed to the development of widely accessible, free training courses for the public, available, among others, via the platform ochronaludnosci.edu.pl, as well as the importance of a safety guide distributed to citizens. He also stressed that broad involvement of community institutions, such as Volunteer Fire Brigades (OSP) and rural women’s associations, will play a significant role in raising public awareness.

Sen. brig. Paweł Janik, D.Sc. Eng., Director of CNBOP-PIB, addressed legislative and systemic issues, pointing to the need for clarifying regulations concerning protective structures, particularly in the areas of financing, research, and implementation of innovations. He noted the absence of a statutory conformity assessment system for such facilities. He mentioned the need to amend regulations concerning construction products by extending their scope to include protective structures, as well as to develop new regulations regarding approval certificates, covering, among others, modern technologies such as robots, drones, and warning and alarm systems. He emphasized that creating mechanisms for verifying the resistance of structures to specific conditions is crucial.

Sen. brig. Rafał Szczypta, M.Sc. Eng., pointed to areas requiring further improvement, emphasizing that current regulations are functional in nature, allowing for technological development and not limiting innovative solutions. However, he noted the need to further specify technical requirements so that applied products are verified in terms of durability and reliability throughout their entire lifecycle, e.g., over a 30-year period and under varying environmental conditions. He also indicated that current requirements were developed based on numerical analyses, modeling, international experience, and the achievements of national research centers, including the Military University of Technology. At the same time, he highlighted significant challenges, such as a shortage of specialists capable of designing such structures and occasional errors in structural calculations.

Attorney-at-law Barbara Puzkarewicz focused on formal and legal aspects related to public procurement. She emphasized the importance of contracting authorities being aware of available tools, including the possibility of applying simplified procedures or exemptions in the field of security. She pointed to the possibility of shortening decision-making processes and implementation timelines, as well as common mistakes made at the stage of preparing procurement procedures, such as insufficient description of the subject of the contract or lack of reference to technical standards. She stressed that the contracting authority is responsible for properly defining needs and subsequently verifying them.

Zenon Małkowski, Ph.D. Eng., representing the Polish Association of Fire Protection and Rescue Equipment Manufacturers, emphasized the need to eliminate randomness in the selection of products used in protective structures. He highlighted, among others, the importance of appropriate door parameters, including their fire resistance and additional fire protection requirements specific to such facilities.

Sen. brig. (ret.) Mariusz Zabrocki, M.Sc. Eng., pointed to the need for a comprehensive approach to building a civil protection system. He emphasized that, in addition to infrastructure such as shelters, key importance should also be given to communication systems, ensuring the supply of food and drinking water, as well as the appropriate distribution and number of shelter places. He also highlighted the importance of building a sense of security among residents and strengthening local communities, as well as the possibility of dual-use infrastructure.

The panel participants also emphasized the important role of the State Fire Service as one of the pillars of the civil protection system, responsible, among others, for organizing evacuation sites and shelter points, as well as maintaining records of available facilities of this type.

1.2. Part 2: Effective civil protection based on new technical and technological solutions

“Effective civil protection based on new technical and technological solutions” – sen. brig. Jacek Zboina, Ph.D., D.Sc. Eng., CNBOP-PIB

The speaker focused on presenting sources of knowledge, inspiration, and examples of implemented solutions. He referred to monographs, including the latest publications of the Fire University, as well as the journal “Safety & Fire Technology.”

The innovations presented included a LoRa-based system for monitoring the closing of fire doors, as well as a solution for extinguishing electric vehicles at charging stations. He also mentioned that, in cooperation with the Association of Fire Protection Engineers and Technicians (SITP), guidelines on the use of intercom systems for civil protection purposes will be developed.

Director Jacek Zboina included the following key points in his presentation:

- building civil protection (CP) structures and resources is a task for the coming years;
- it requires both long-term planning and immediate action;
- the foundation for developing CP resources lies in knowledge and experience in this field (including that of other countries);
- solutions in this area can now be implemented more effectively than in the past by combining knowledge, experience, and currently available technologies and technical solutions;
- implementing solutions from other countries often requires adaptation to national conditions;
- it is necessary to develop domestic capabilities for production, maintenance of systems, and solutions;
- civil protection requires further development of solutions and clarification of its vision in the coming years, along with a long-term plan;
- new technical and technological capabilities create new opportunities for improving the effectiveness and efficiency of civil protection;
- there is potential for effective expansion and integration of warning and alarm systems (WAS) with fire protection systems and devices to improve notification, alerting, and evacuation support;
- numerous new or adapted solutions from other fields are available for civil protection, including those for emergency communication and warning systems.

1.2.1. Discussion panel 2: What products, systems, and solutions are needed for civil protection in Poland?

The panel was attended by: **sen. brig. Marek Marzec, Ph.D. Eng.;** **sen. brig. Tomasz Kołodziejczyk, M.Sc. Eng.;** **Tomasz Popielarczyk, Ph.D. Eng.;** **Adam Buczyński;** and **Wojciech Pancer.**

The discussion focused on challenges related to building a modern, resilient public warning and alerting system and its integration with other elements of the safety system.

Sen. brig. Tomasz Kołodziejczyk, M.Sc.Eng., pointed to the evolution of approaches to warning systems. He emphasized that earlier trends of moving away from alarm sirens have been reassessed in light of the full-scale war in Ukraine, which demonstrated that traditional solutions remain indispensable. At the same time, he highlighted the vulnerability of modern technologies to disruptions and external attacks, which justifies the need for multi-channel solutions. He also drew attention to the need to modernize resources for crisis management within the Government Centre for Security (RCB), as well as to gaps in data collection systems regarding losses caused by natural disasters and industrial accidents. In a broader context, he addressed water management issues in Poland, pointing to the negative effects of long-term drainage processes, such as declining groundwater levels, peatland degradation, and increased risk of droughts and fires. He emphasized the importance of public education in water resource protection and environmental resilience.

Sen. brig. Marek Marzec, Ph.D. Eng., emphasized the need for a systemic approach to building an effective warning and alerting system based on multiple communication channels. He stressed that technology alone is not sufficient—public education and adapting communication methods to changing realities are equally important. He also referred to the assumptions of the new civil protection program, including the development of collective protection facilities, educational activities, and long-term financial investments. He highlighted the need to link evacuation plans with warning systems and the availability of shelter locations, as well as the important role of entities such as Volunteer Fire Brigades (OSP) and units of the State Fire Service.

Tomasz Popielarczyk, Ph.D. Eng., pointed to the need for further improvement of the current warning and alerting system, indicating the possibility of using existing fire protection infrastructure. He emphasized that fire alarm systems, equipped with visual and audible signaling devices as well as voice messages, can be used to deliver warnings to the public, for example in facilities such as metro stations or shopping centers. He highlighted the need to integrate fire protection and commercial systems and to utilize alarm transmission devices. He also stressed the importance of reliability, regular maintenance, and the ability to verify device parameters under laboratory conditions. The use of voice alarm systems (VAS) or fire alarm systems (FAS) for civil protection purposes has the advantage that these are familiar systems that users already know how to operate.

Wojciech Pancer focused on technological and market aspects, pointing to an existing gap in solutions dedicated to public warning systems. He emphasized the need to ensure redundancy both in transmission (e.g., TETRA, GSM, internet links) and system control, as well as resistance to interference, including jamming. He highlighted the importance of intelligibility of voice messages and the need to develop sirens capable of broadcasting them. He also pointed to the role of new technologies, such as satellite communication (e.g., Starlink), and the importance of technological and logistical sovereignty, including the development of domestic production capabilities.

Adam Buczyński addressed practical aspects of implementation and operation of systems, pointing to the potential of adapting tunnel infrastructure for civil protection purposes. He emphasized that road tunnels—due to their structure and equipment—can serve as shelters and are already partially

prepared, as they provide power supply, communication systems, and lighting. However, such solutions would require addressing sanitary infrastructure. He also highlighted the need to educate the public on appropriate behavior in such facilities.

During the Q&A session, participants pointed, among others, to the challenge of integrating public warning systems with fire service notification systems, which is currently being addressed. They also discussed challenges related to the limited effectiveness of traditional warning methods when part of the population uses noise-cancelling headphones. In this context, the need to develop alternative forms of communication, such as light signals, information boards, and other visual warning systems, was emphasized.

1.3 Summary and conclusions from Session 1

Session 1, dedicated to civil protection solutions, demonstrated a clear shift in the approach to safety—from reactive measures to systemic, integrated planning based on knowledge, technology, and international experience. In the part concerning protective structures, it was emphasized that modern shelters and refuge facilities must meet not only traditional structural requirements but also address fire safety, energy independence, and operational continuity in crisis situations. Increasing importance is attached to modern technologies such as air filtration and ventilation systems, environmental monitoring, fiber-optic communication, and alternative power sources.

The discussion panel on the design and construction of protective structures highlighted that infrastructure alone is not sufficient—systemic aspects are equally important, including legislation, quality verification mechanisms, availability of qualified personnel, and proper preparation of investment processes. The importance of public education and building societal resilience as integral elements of the civil protection system was also emphasized.

The second part of the session broadened the perspective to include new technical and technological solutions. It was indicated that the development of civil protection should be based on integrating existing systems, adapting proven solutions from other countries, and leveraging modern communication and information technologies. Particular attention was paid to warning and alerting systems, which should be multi-channel, resilient to interference, and integrated with other elements of safety infrastructure.

The discussion panel demonstrated that building an effective civil protection system requires combining traditional solutions (e.g., alarm sirens) with modern technologies, while ensuring redundancy, reliability, and resilience to threats, including cyberattacks and radio interference. It also highlighted the need for better use of existing infrastructure, such as fire protection systems and engineering structures (e.g., tunnels), as well as the development of new forms of communication with the public, including visual methods.

Conclusions:

- Civil protection requires a systemic approach that integrates infrastructure, technologies, legal regulations, and public education.
- Protective structures should be designed as multifunctional, resilient facilities equipped with modern technical systems ensuring their autonomous operation.
- It is necessary to further clarify regulations and establish mechanisms for quality and conformity assessment of protective structures and the solutions used within them.
- A key challenge remains the shortage of specialized personnel and the need to enhance the competencies of designers and contractors.

- Warning and alerting systems should be multi-channel, redundant, and resilient to interference, while being integrated with existing infrastructure.
- Modern technologies provide significant support; however, they do not replace the need for public education and preparedness for appropriate response.
- It is essential to develop domestic technological and production capabilities, which increases system security and independence.
- The integration of planning, infrastructure, and operational systems (e.g., evacuation, communication, sheltering) forms the foundation of effective civil protection in the future.

2. SESSION 2. SOLUTIONS FOR FIRE PROTECTION AND CIVIL PROTECTION

“We have a solution – just not for this problem” – Dr.-Ing. Sylvia Pratzler-Wanczura, Institute for Fire and Rescue Technology (IFR), Dortmund Fire Service

In her presentation, Dr.-Ing. Sylvia Pratzler-Wanczura highlighted a key issue in civil protection projects—their misalignment with the real needs of end users. She emphasized that solutions should be driven by actual needs, not by pre-existing ideas imposed on users.

She pointed out that every solution should be evaluated in terms of its practical usefulness—whether it truly addresses the problem, whether it is up to date, and whether it can be implemented both technically and financially. Otherwise, systems remain unused or are bypassed, user trust declines, and financial resources are spent inefficiently.

A crucial element of effective design is genuine—not merely formal—involvement of end users. As she noted, the fire service should act not only as a consultation participant but also as a co-designer, tester, and co-decision-maker. She also stressed the importance of testing solutions under realistic conditions, including stress, time pressure, and incomplete information, since solutions that work only in laboratory settings often fail in practice.

She highlighted the need to ensure interoperability of systems and their compatibility with existing infrastructure and stakeholders. Ease of use is equally important—solutions must be intuitive and usable in operational conditions without requiring extensive training.

She also emphasized the importance of considering administrative and procurement constraints early on, noting that even the best solutions will not be implemented if they do not fit real-world procedures and budgets. Ensuring project sustainability after completion—including maintenance, updates, and operational funding—is also essential.

Another important aspect is reliable project evaluation, covering not only successes but also identifying problems and causes of failure. She stressed the need for an iterative design approach, allowing solutions to adapt to changing conditions.

She also pointed to the importance of effective communication between academia, practitioners, and industry, noting that many problems stem not from technological limitations but from communication barriers. She emphasized the need to focus on key functionalities rather than overcomplicating systems.

In conclusion, she stressed that one of the most important indicators of success is user acceptance—whether the solution is actually used and trusted. As an example of a successful approach, she presented the civil protection innovation ecosystem operating in Dortmund.

“The use of drone technology in crisis management and civil protection – today’s and tomorrow’s perspective” – Eng. Joanna Sadowska, CNBOP-PIB

Under the current legal framework, local government units have shifted from the role of a “formal coordinator” to that of a local safety operator. The Act on Civil Protection and Civil Defence has shifted the focus from response to preparedness—and unmanned aerial systems (UAS) are tools that make this transition possible.

The speaker presented the relationship between the responsibilities of local governments in civil protection and civil defence and the support capabilities offered by drones. She noted that local governments perform a range of key tasks, including threat monitoring, reconnaissance, damage assessment, infrastructure supervision, evacuation support, coordination of actions, and public warning.

She emphasized that modern technologies, including drones, can significantly support these tasks. Key UAS functionalities include rapid data acquisition, aerial observation, situation documentation, threat detection, image analysis, decision-making support, and real-time monitoring.

She pointed out that integrating local government activities with UAS technology creates a synergy effect, leading to tangible operational benefits. In particular, it enables faster situation assessment, improved situational awareness, better decision-making, and more effective emergency response—ultimately enhancing public safety.

She noted that the use of drones in civil protection is a key direction for the development of modern crisis management, increasing both efficiency and quality of operations. She also emphasized the important role of training in developing competencies related to modern technologies, particularly drones. As an example, she highlighted the activities of the CNBOP-PIB Drone Center and the new educational and training project “Wings for the County.”

In the latter part of her presentation, she outlined future development directions, pointing to the growing importance of automation and artificial intelligence. She mentioned the development of BVLOS operations, dock station systems, and integration with Internet of Things (IoT) and smart city systems.

She also highlighted the dynamic growth of logistics applications, including the use of drones and mobile robots, as well as the increasing role of AI-based data analysis. She emphasized the importance of environmental sensors, responder localization systems, and monitoring.

In conclusion, she noted that the future of this field will be based on increasing integration of aerial and ground platforms, enabling the creation of cohesive and effective systems supporting operations and crisis management.

“Intercom systems as a new chapter in safety technology” – Eng. Michał Róžański, Ambient System

Eng. Michał Róžański, Product Manager at Ambient System, presented the role of intercom voice communication systems in modern safety systems. He discussed the challenges faced by critical

communication systems and identified intercoms as an important component of integrated safety environments. He also presented key features and practical applications of these solutions.

He explained that an intercom is a voice communication system enabling direct communication between different points within a building, industrial facility, vehicle, or other environment. He emphasized that such systems significantly enhance safety by supporting operational procedures and enabling efficient information distribution.

Among the key features, he highlighted wide coverage—both indoors and outdoors—and the ability to integrate with other safety and life protection systems. He also noted the scalability of the solution, making it suitable for facilities of various sizes and purposes. He emphasized advanced technical capabilities that eliminate issues typical of traditional communication systems, such as interference or poor speech intelligibility.

Examples of applications include healthcare facilities, laboratories, clean rooms, and operating theatres—environments where mobile device use is limited. He also mentioned correctional facilities and transport infrastructure, including tunnels and metro systems. In mass-use scenarios, he pointed to INFO-SOS points in public spaces.

In conclusion, he noted that modern mass notification systems (MNS) combine intercom functionalities with public address systems, enabling both two-way communication and effective dissemination of voice messages over large areas.

“Apparent availability vs. operational readiness: the need for system-based AED monitoring based on practices in other EU countries” – Przemysław Grabowski, GRAS

Przemysław Grabowski highlighted the important issue of the gap between the declared availability of automated external defibrillators (AEDs) and their actual operational readiness. He stressed that simply placing devices in public spaces does not guarantee their effectiveness—ensuring full functionality and accessibility in life-threatening situations is key.

He reminded that defibrillation performed within 3–5 minutes of cardiac arrest can increase survival chances to 50–70%. However, AEDs save lives only when they are accessible and operational. In practice, devices are often located in inaccessible places (e.g., locked buildings) or are non-functional due to missing batteries or damage, including theft.

He paid particular attention to environmental factors affecting AED performance. He noted that devices are sensitive not only to temperature (which may cause electrode gel to freeze) but also to humidity, UV radiation, and internal temperature fluctuations. Standard AED cabinets often fail to provide sufficient protection, leading to equipment degradation and reduced readiness.

He also expressed concern about the lack of mandatory AED registration in central systems in Poland and many European countries. He pointed to good practices in countries such as Portugal, where systems for registration, monitoring, and integration with emergency services are in place. He also discussed developments in Germany and Italy, where system-based approaches to AED management are gaining importance.

As a solution, he proposed advanced AED cabinets functioning as active monitoring systems. These maintain proper operating conditions through cooling, heating, and ventilation systems.

He also emphasized monitoring features such as alarms for opening or removal, enabling rapid response to use, tampering, or theft. A key element is communication with the defibrillator and remote status monitoring, reducing the risk of a false sense of security.

Integration with online monitoring systems enables centralized management of multiple devices, real-time status tracking, alarm notifications, and event history. These systems also support maintenance management and ensure compliance with manufacturer guidelines.

In conclusion, he stressed the need to move from a focus on mere availability to ensuring real operational readiness, requiring both appropriate regulations and modern technological solutions.

“Spatial development studies and local spatial development plans as sources of information for crisis response planning” – M.Sc. Eng. Arch. Maria Witośławska

The speaker emphasized that spatial planning is not only a development tool but increasingly serves as a means of risk prevention and national security building. She noted that proper spatial design can ensure appropriate building locations, evacuation route accessibility, rational distribution of critical infrastructure, and protection of flood-prone and green areas.

She pointed out a systemic issue—the lack of full integration between spatial planning and crisis management. In Poland, these areas largely operate in parallel, meaning available data is not fully utilized despite attempts to combine them.

She emphasized that planning documents, such as general and local plans, are valuable but underutilized sources of information for crisis management. While general plans do not directly manage crises, they create conditions that determine the effectiveness of emergency services.

Local plans, however, serve as practical prevention tools. At this level, it is possible to designate evacuation sites, ensure appropriate road parameters for emergency services, limit development in hazardous areas, and plan dual-use facilities such as schools serving as shelters. They can also support the location of protective structures and increase building resilience.

She noted that current planning projects do not always sufficiently consider civil protection, despite its importance for operational practice. She also pointed to the potential of new tools, such as the Urban Planning Register, which — using modern technologies including AI — can support spatial data analysis and decision-making.

She stressed the need to closely integrate spatial planning with the broader safety ecosystem, including emergency services, administration, and local communities. Particular importance lies in the area of cooperation, where planning and operational activities intersect — through risk analysis, response procedures, evacuation simulations, and integrating safety into investments.

In conclusion, she emphasized that a coherent, systemic approach can effectively reduce risks and enhance community resilience and safety.

Civil protection in selected EU countries” – Senior Brigadier (ret.) M.Sc. Eng. Jan Kielin, M.Sc. Eng. Damian Bąk, CNBOP-PIB

The speaker presented the functioning of the civil protection system at the EU level, noting that a key role is played by the European Commission and its Directorate-General for European Civil Protection

and Humanitarian Aid Operations. Within its structure operates the Emergency Response Coordination Centre (ERCC), responsible for coordinating actions in crisis situations.

He discussed the main elements of the EU Civil Protection Mechanism, including obligations related to risk management and reporting, knowledge exchange, joint exercises, early warning systems, and the use of human and material resources in cross-border operations. He also highlighted the importance of transport and funding regulations and the EU's involvement in international assistance operations.

He emphasized that civil protection is integrated into various EU policy areas, such as climate protection, development aid, and foreign policy, strengthening disaster prevention efforts. A key milestone was the Lisbon Treaty, which introduced a distinct EU competence in civil protection covering all phases—from prevention and preparedness to response.

He also referred to national solutions, discussing civil defence systems in countries such as France, Germany, the United Kingdom, and Switzerland. In this context, he highlighted the practical importance of the “Civil Protection Handbook” published by the German Federal Office of Civil Protection and Disaster Assistance, which serves as a comprehensive guide for practitioners, covering theoretical foundations, legal frameworks, tools, operational scenarios, and cross-border cooperation.

2.1. Summary and conclusions from Session 2

Session 2, focused on solutions for fire protection and civil protection, demonstrated that the effectiveness of modern technologies depends not so much on their innovativeness as on their actual alignment with user needs, operational conditions, and existing systems. The presentations covered a wide range of topics—from user-centered design, through the use of drones, intercoms, and AED monitoring systems, to the role of spatial planning and the experiences of European countries in building resilience.

A strong message emerged that new technologies should be implemented as part of a coherent system rather than as isolated, standalone tools. This applies both to unmanned aerial systems supporting crisis management and to voice communication systems, which can be used in civil protection, fire protection, and facilities with specific safety requirements. It was emphasized that their value increases when they are integrated with other solutions, easy to use, and embedded in real operational procedures.

Another key theme was the need to move from apparent availability to actual operational readiness. This was particularly evident in the case of AEDs, where the mere placement of devices does not guarantee effectiveness without technical monitoring, proper storage conditions, registration, and maintenance systems. It was shown that similar logic applies more broadly to safety—reliability, supervision, and the ability to continuously verify system performance are crucial.

An important part of the session focused on spatial planning as a tool for prevention and resilience building. It was pointed out that safety should be considered already at the stage of shaping space—when locating buildings, designing evacuation routes, distributing critical infrastructure, and securing hazard-prone areas. The need for close integration between spatial planning documents and crisis management frameworks and actions was strongly emphasized, as well as the implementation of appropriate provisions in legal acts so that planning genuinely supports safety.

Attention was drawn to the fact that new general plans, despite their simplified format, offer an opportunity to introduce systemic solutions; however, they should already involve emergency services—especially the State Fire Service—at the drafting stage. These documents should include, among others, assembly points, evacuation scenarios, and risk analyses such as flood threats. The need for better use of planning data in the era of digitalization was also highlighted, along with the gap between growing needs for protective infrastructure (e.g., shelters) and their insufficient reflection in planning documents.

The session also demonstrated the importance of learning from other countries. A review of solutions used in EU and non-EU countries showed that an effective civil protection system is based on a combination of regulations, exercises, cross-border cooperation, knowledge exchange, and practical tools supporting emergency services and administration. Additionally, drawing on Nordic experience, the importance of preparing society for crisis situations from an early age was emphasized, including building psychological resilience and developing the ability to recognize disinformation.

Overall, the session confirmed that modern civil and fire protection increasingly rely on the integration of technology, data, planning, and human competencies. It is the human factor—user, operator, responder, designer, or decision-maker—that remains the ultimate determinant of the effectiveness of any solution. Equally strong was the call for cooperation between different communities: urban planners, emergency services, crisis management specialists, and representatives of new technologies, including drone operators.

Conclusions:

- Technologies are useful only when they address real user needs and are designed with their active involvement.
- Drones already provide real support for civil protection, but their importance will grow significantly when they become part of early response systems rather than standalone equipment.
- Local government units play an increasingly important role in local safety systems and should be strengthened in terms of both competencies and technology.
- Critical communication and warning systems should be integrated, scalable, intuitive to use, and resilient to disruptions, and their development should consider the needs of different user groups.
- In the case of AEDs, ensuring real operational readiness is key, rather than merely formal availability in public spaces.
- Spatial planning and crisis management are closely linked but still insufficiently integrated; without considering safety aspects at the planning stage, it is difficult to build resilient environments.
- It is necessary to link spatial development plans with civil protection and crisis response documents and to properly anchor these relationships in legal frameworks.
- General plans should strengthen spatial resilience, while local plans remain one of the most important practical tools supporting safety and emergency services operations.
- Planning data is a valuable resource for civil protection but is still underutilized in operational practice; its digital processing should support concrete decisions and actions.
- Emergency services should be involved earlier and more broadly in the planning process to account for evacuation, shelter locations, assembly points, and threat scenarios.

- Experiences of European countries show that effective civil protection requires a combination of regulations, exercises, inter-institutional cooperation, and continuous improvement of practice.
- It is worth developing public education inspired by Nordic solutions, including psychological resilience, crisis preparedness, and the ability to recognize disinformation.
- The future of this field will rely on automation, data analysis, and system integration, but human competence will remain the decisive factor in their effectiveness..

3. Session 3 – NEW TECHNOLOGIES AND THEIR SAFETY

“A resilient society as the key to safety – how modern technologies support contemporary social prevention activities” – Marta Wawiórko, National Headquarters of the State Fire Service; sen. capt. Aleksandra Świstel, Provincial Headquarters of the State Fire Service in Gorzów Wielkopolski

The speakers, Marta Wawiórko – Head of the Social Prevention Department at the National Headquarters of the State Fire Service – and Senior Captain Aleksandra Świstel, holding an independent position for social prevention at the Provincial Headquarters of the State Fire Service in Gorzów Wielkopolski, presented the issue of building a resilient society as one of the key elements of safety, emphasizing the role of social prevention supported by modern technologies.

They pointed out that social prevention includes a wide range of educational, informational, and promotional activities aimed primarily at children and young people, as well as seniors and persons with disabilities. Its main goal is to raise awareness of hazards, especially those occurring in the immediate environment, and to shape proper behavior in crisis situations. The intended outcome of these activities is to reduce the number of fatalities and injuries, particularly in residential building fires.

The speakers discussed the most important social campaigns carried out by the State Fire Service, such as “A Detector on Guard for Your Safety”, whose importance will increase in connection with the requirement to install detectors in all residential buildings from 2030, as well as the “Stop Grass Fires” campaign. They also highlighted extensive educational activities conducted in the form of picnics, events such as Museum Nights, the “Safe Holidays” and “Safe Winter Break” programs, and classes in educational rooms operating at State Fire Service units.

They emphasized the importance of available teaching materials and lesson plans that support large-scale educational activities. They also noted the growing role of modern technologies in education, including the use of virtual reality (VR), which enables the creation of immersive, interactive scenarios teaching decision-making in hazardous situations. These activities are complemented by a mobile fire hazard simulator in the form of a miniature house.

In conclusion, the speakers indicated that effective social prevention, supported by modern educational tools, is an important element in building societal resilience. The scale of these activities is significant—nearly 1.9 million people were reached in 2024 alone, confirming their growing importance in the safety system.

Important links

<https://www.gov.pl/web/kgpsp>(<https://www.gov.pl/web/kgpsp>)

<https://www.gov.pl/web/kgpsp/prewencja-spoleczna-psp>

](<https://www.gov.pl/web/kgpsp/materialy-dydaktyczne>)

“The use of AI in fire protection” – M.Sc. Eng. Robert Śliwiński, CNBOP-PIB

The speaker discussed the basic assumptions of Regulation (EU) 2024/1689 of the European Parliament and of the Council (AI Act), focusing on the definition of an artificial intelligence system and its practical implications for various sectors, including fire safety. He indicated that AI systems are solutions with a certain level of autonomy, capable of adaptation and inference based on data, which distinguishes them from traditional systems based solely on rigid rules.

He emphasized that the development and deployment of AI require a change in the approach to system assessment and verification, including consideration of their adaptive capabilities and decision-making processes. He pointed out challenges related, among other things, to the interpretation of outputs generated by AI systems and their role in complex, often distributed technical systems.

A significant part of the presentation was devoted to the use of artificial intelligence in fire safety design. He presented examples of AI models being used to analyze smoke spread in buildings with complex geometry, indicating their high effectiveness and their potential to reduce design time and costs while maintaining high accuracy.

He also discussed the concept of intelligent fire response systems based on Edge-AI technology. Such a system was designed as a multi-layered, integrated platform combining early detection, automatic smoke extraction, local extinguishing, and real-time communication. Individual components—from sensors and actuating modules to the control system—cooperate within a single operational environment, enabling automatic information transfer and the immediate initiation of coordinated actions.

A key element of the solution is a hybrid detection unit combining smoke and temperature sensors with an embedded AI processor. The system uses convolutional neural networks (CNNs), trained on data specific to fire scenarios, enabling real-time analysis of parameters such as smoke density and temperature changes directly on the device. Thanks to local data processing, delays can be eliminated and appropriate response procedures can be launched quickly.

The speaker stressed that integrating various data sources and simultaneously analyzing signals such as smoke presence and temperature rise significantly increases detection accuracy and makes it possible to substantially reduce the number of false alarms. As a result, the system responds only to actual threats.

In conclusion, he indicated that the use of artificial intelligence in fire protection opens up new possibilities for the design and operation of safety systems, contributing to a significant reduction in risk and improved response effectiveness.

“Technologies enhancing firefighter safety: location tracking, vital signs monitoring, and other emerging solutions based on R&D experience” – Mikołaj Car, CNBOP-PIB

The speaker presented experience related to the use of modern technologies enhancing firefighter safety, with particular emphasis on location tracking systems and vital signs monitoring. He referred to the SYNERGISE research and development project, carried out in international cooperation,

including with the participation of IFAFRI, an organization bringing together institutions from many countries and the European Commission.

He indicated that analysis conducted at the international level made it possible to identify key technological gaps in the field of rescue operations, including the lack of effective firefighter location systems, real-time hazard monitoring, data integration, and reliable communication. He emphasized that addressing these gaps is the foundation for the further development of modern systems supporting rescue operations.

In this context, he presented the concept of integrated systems aimed not only at improving firefighter safety through ongoing monitoring of their health status and location, but also at building a Common Operational Picture (COP), enabling more effective decision-making by incident commanders.

He devoted particular attention to the NIT-CRES architecture, an example of a “system of systems” solution integrating data from various sources—sensors, drones, and robots—and supporting cooperation between different services. This system is based on a multi-layer structure including a communications layer ensuring stable connectivity (including the use of 5G technology, mesh networks, and satellite communication), an operational layer covering field activities, and a decision layer where data analysis and command support take place.

The speaker emphasized the importance of data fusion and the use of artificial intelligence for real-time processing, making it possible to present information in a simplified, operational form. He also pointed to the role of so-called ethical and explainable AI (XAI), which supports the decision-making process but does not replace humans—the final decision always remains with the rescue operation commander.

He also indicated the possibility of remotely supporting operations through the transmission of images and data to experts, allowing for ongoing consultations and increasing operational effectiveness.

In conclusion, he emphasized that the development of modern technologies does not lead to the full automation of rescue operations, but rather to supporting firefighters by reducing risk and information overload. He stressed that despite the growing role of technology, experience, empathy, and human decision-making remain crucial in rescue operations.

“Technology alone is not enough – the Integrated Qualifications System: results of previous activities, current status of work, and implementation” –Paweł Gancarczyk, M.Sc. Eng., CNBOP-PIB

Paweł Gancarczyk, head of the CNBOP-PIB Service Certification Unit, presented the scope of activity of the unit he manages, which deals with the verification and certification of companies in the field of design, installation, and maintenance of fire protection systems, as well as audits of such systems in buildings.

The main topic of his presentation was the qualifications and competencies of people involved in the design, installation, and maintenance of fire protection devices, and the possibilities for formally verifying and confirming these competencies. Referring to his own professional experience, the speaker pointed to numerous design errors, particularly in extinguishing systems. He emphasized that individuals with general engineering competencies do not always possess sufficient specialist knowledge in the field of fire protection.

In response to identified needs, CNBOP-PIB, in cooperation with the Educational Research Institute, developed seven market qualifications in the field of fire protection, covering both the design as well as installation and maintenance of systems such as voice alarm systems (VAS), fire alarm systems (FAS), and fixed extinguishing systems. These qualifications were published in the Monitor Polski, and CNBOP-PIB serves as the certifying body responsible for validation and confirmation of competencies.

The speaker noted that the certification process is carried out within the Integrated Qualifications System and the Polish Qualifications Framework, which describes the level and complexity of acquired skills. Information on the PQF level is included on every issued certificate.

In conclusion, he stated that one of the qualifications has already been implemented, under which 419 certificates have already been issued, demonstrating growing demand for competency confirmation in this field.

“Work on the use of new solutions for fire protection and civil protection – guidelines for voice communication systems” –Tomasz Popielarczyk, Ph.D. Eng., CNBOP-PIB

Tomasz Popielarczyk, Ph.D. Eng., head of the CNBOP-PIB Laboratory of Fire Alarm Systems and Fire Automation, presented the status of work on guidelines concerning voice communication systems in emergency situations. He referred to already existing documents, such as guidelines for voice alarm systems and systems integrating fire protection devices, developed by CNBOP-PIB and SITP.

He indicated that work is currently underway on new guidelines for voice communication systems (SKGA), intended to enable two-way communication between key points in a facility and a central control station. He emphasized that these solutions will have broad application, including communication with people with various needs, emergency responders, and event safety staff. He noted the need to integrate these devices so that calls can be forwarded and serve multiple functions.

The speaker also discussed the standards forming the basis of the guidelines under development and their planned structure. He noted that publication of the document is scheduled for June 2026.

“Analysis of the effectiveness of extinguishing energy storage systems with gases” – Brigadier M.Sc. Eng. Wojciech Klapsa, CNBOP-PIB

Brigadier Wojciech Klapsa, M.Sc. Eng., head of the CNBOP-PIB Laboratory of Combustion Processes and Explosions, began his presentation by describing the scope of the laboratory’s activities, which include testing construction materials, interior finishing materials, flammable liquids and dusts, fans, hydraulic tools, engine compartment extinguishing systems, materials used in vehicles, as well as lithium batteries and energy storage systems.

He then referred to applicable standards and guidelines, pointing, among others, to NFPA 855, which requires fire testing of energy storage systems at the unit or whole-installation level (in practice, entire installations are tested), and PN-EN IEC 62933-5-2 concerning the safety of electrochemical systems. He also referred to UL 9540A, which defines methods for testing the effectiveness of extinguishing systems (including gas, water mist, and combined systems) under near-real conditions, although it is mainly limited to indoor installations. He also mentioned VdS procedures, while emphasizing the lack of a uniform design standard for gaseous extinguishing of energy storage systems.

A key part of the presentation was the discussion of the effectiveness of various gaseous extinguishing agents based on scientific research results. The speaker referred, among others, to experiments involving heptafluoropropane (HFC-227ea), which showed high effectiveness in extinguishing open flame and preventing re-ignition in the short term, but limited ability to inhibit battery cell temperature rise. He indicated that for large battery systems, the effectiveness of this agent decreases and complete extinguishment remains difficult.

Similar conclusions were presented for perfluorohexanone (Novec 1230), which effectively suppresses flame and works through physical cooling and combustion reaction inhibition mechanisms; however, when concentration drops, re-ignition may occur even after a short time. In addition, its heat absorption capacity is not always sufficient in the event of fully developed thermal runaway.

Carbon dioxide (CO₂), despite advantages such as leaving no residue and good insulating properties, was assessed as having limited effectiveness — studies showed that it does not provide adequate cooling, allowing battery temperatures to continue rising and degradation processes to proceed.

Against this background, liquid nitrogen stands out, which, according to studies, is characterized by very high cooling efficiency and may effectively delay or prevent the development of thermal runaway. However, its use is hindered by logistical requirements, storage problems, and risks associated with low temperatures and asphyxiation.

The speaker pointed out that a common drawback of most gaseous extinguishing agents is the lack of long-term cooling capability and the risk of re-ignition. Their advantages remain the absence of residue and the possibility of application in enclosed spaces without damaging equipment.

An important element of the presentation was the analysis of full-scale tests (including with the use of Novec 1230), which showed that even after successful flame extinguishment, flammable gases may accumulate in the system. If oxygen is introduced—for example, when a container is opened—ignition and even deflagration may occur, posing a serious threat to firefighters.

In conclusion, based on the results of scientific studies and tests, the speaker emphasized the need to change the approach to the design of protection systems for energy storage systems. He pointed to the need to apply comprehensive solutions including early detection, module separation, combining different extinguishing agents (e.g. gaseous and water-based), sequential agent discharge, and functional testing of entire installations.

Important links

<https://cnbop.pl/oferta/badania-laboratoryjne/zespol-laboratoriow-bw/zespol-laboratoriow-procesow-spalania-i-wybuchowosci-bw/>

<https://doi.org/10.3390/en16072960>

<https://doi.org/10.1007/s10694-022-01278-3>

3.1. Discussion panel 3: “Fire safety of new technologies, new products, and solutions”

The discussion panel entitled “Fire safety of new technologies, new products, and solutions”, moderated by Senior Brigadier Dr. Hab. Eng. Paweł Janik, brought together a wide range of experts representing different communities. Participants included: Senior Brigadier Daniel Małozieć, M.Sc. Eng. – Deputy Director of CNBOP-PIB for Research and Development, Brigadier Wojciech Klapsa, M.Sc.

Eng. – head of the CNBOP-PIB Laboratory of Combustion Processes and Explosions, Mariusz Sobecki, M.Sc. Eng. – SITP, Prof. Dariusz Zieliński – PSME, Krzysztof Kochanowski – President of the Management Board of PIME, Marek Magdziarz – representative of SEP, and Paweł Rochala – editor-in-chief of the quarterly *Ochrona Przeciwożarowa*.

During the panel, it was emphasized that the development of new technologies, especially energy storage systems, is inevitable and requires finding a balance between safety and innovation. It was pointed out that the pace of technological development often outstrips legal regulations and available research results, which generates significant challenges for designers, emergency services, and public administration.

An important topic was the integration of systems and their reliability. Panelists noted that modern solutions should be designed as multifunctional systems and used as broadly as possible, which supports better maintenance and oversight. At the same time, it was emphasized that integration—although inevitable—is associated with numerous challenges, and every system is only as strong as its weakest link. In this context, the need for certification of entire systems, rather than only individual devices, was highlighted.

Considerable attention was devoted to emergency communication systems, including solutions ensuring two-way communication, especially with people with special needs. The lack of coherent standards and the inadequacy of existing standards for national conditions were emphasized; therefore, work has been undertaken on developing guidelines adapted to Polish realities, in cooperation with CNBOP-PIB.

In the area of energy storage systems, the discussion focused on fire and explosion hazards, including those related to hydrogen emissions and the properties of various battery types. Significant differences between technologies were pointed out—lithium iron phosphate batteries are considered more stable, whereas sodium-ion technologies, despite dynamic development, may currently be characterized by greater flammability and explosion susceptibility. The importance of proper installation siting, maintaining adequate distances, and using solutions combining passive and active protection was emphasized.

Panelists also drew attention to hazards related to the formation and accumulation of flammable gases and the need for proper design of ventilation systems. The issue of computational analyses (CFD) was also raised, as they often rely on unverified or incorrectly assumed inputs, especially regarding fire power, which may lead to incorrect design conclusions.

The discussion also emphasized the importance of organizational and social aspects such as user education, transparency of actions, industry responsibility, and the role of insurance in shaping safety standards. It was noted that in the case of installations in residential buildings, the safety of all residents and informed decision-making by users are of key importance.

Panel conclusions:

- the development of new technologies is inevitable and must go hand in hand with the development of regulations and research,
- a systemic approach is necessary, covering integration and certification of entire solutions,
- there is an urgent need to develop guidelines adapted to Polish conditions, especially in the field of emergency communication and energy storage systems,
- proper design, spacing, ventilation, and combining protection methods are of key importance,
- design analyses require reliable verification of input data and assumptions,

- further research on new technologies and their hazards is necessary,
- user education, industry responsibility, and transparency of action play an important role,
- safety should be built on a compromise between technical requirements, economics, and social needs.

3.2. Summary and conclusions from Session 3

Session 3 was focused on new technologies and the conditions for their safe and responsible implementation. It showed that innovations can realistically strengthen fire protection and public safety, but only when they are grounded in user competencies, appropriate procedures, research, and standards.

In the first part, the importance of education and social prevention was clearly emphasized. Modern tools such as VR and mobile hazard simulators support the building of a resilient society, but the foundation remains a conscious citizen prepared to respond properly to threats.

Subsequent presentations showed the growing role of artificial intelligence and advanced decision-support systems. AI can improve threat detection, reduce false alarms, speed up data analysis, and support the design of protective measures, but it does not replace humans. Similarly, firefighter monitoring, location tracking, telemetry, and common operational picture technologies increase operational safety, but their effectiveness depends on the integration of multiple data sources, reliable communication, and proper use by commanders.

The issue of competencies also resonated strongly. Technology alone does not guarantee safety if it is not accompanied by confirmed qualifications of designers, installers, and maintenance personnel. In this context, great importance was attached to personnel certification and the development of the Integrated Qualifications System.

An important area of the session was voice communication and emergency communication systems, which should be designed as integrated, multifunctional solutions adapted to the real needs of users, including persons with special needs.

A great deal of attention was also devoted to hazards associated with energy storage systems. The presented research and panel discussion showed that the development of these technologies requires the parallel development of risk assessment methods, design guidelines, extinguishing effectiveness studies, and solutions combining passive and active protection. It was emphasized that new energy technologies are necessary and will continue to develop, but their safety must be built on knowledge, testing, and responsible design.

The entire session confirmed that the future of fire protection belongs to integrated solutions—combining education, AI, firefighter support systems, certified competencies, critical communication, and research into new hazards. At the same time, it was clearly emphasized that ultimately it is the human being—well prepared, aware, and supported by technology—who remains the most important element of the safety system.

4. Session 4 – SOLUTIONS FOR FIREFIGHTERS

**“Needs and solutions regarding firefighter safety” – Brigadier Jacek Zalech, M.Sc. Eng.
National Rescue Coordination Centre, National Headquarters of the State Fire Service**

Brigadier Jacek Zalech, M.Sc. Eng. from the National Rescue Coordination Centre of the National Headquarters of the State Fire Service presented issues related to firefighter safety, discussing both applicable legal regulations and current challenges and directions of technological development in this area.

At the outset, he referred to the legal basis regulating firefighter safety, namely the 2021 regulation of the Ministry of the Interior and Administration concerning occupational health and safety conditions in service, and the 1992 regulation of the Council of Ministers specifying the powers of the rescue operation commander. He emphasized that guidelines and standards of the National Headquarters of the State Fire Service also play an important role.

The speaker presented statistical data showing that despite a decrease in the number of fires, the number of incidents resulting in firefighter deaths or injuries has shown an upward trend. To illustrate the issue, he referred to specific incidents. In this context, he drew attention to the need to improve communication and firefighter location systems in hazard zones.

He noted that work is underway at the National Headquarters of the State Fire Service on new solutions in this area, based on decisions of the Commander-in-Chief of the State Fire Service. This includes, among other things, the development of firefighter location systems, monitoring of vital parameters, increased communication effectiveness, and improved visibility in difficult operational conditions.

A significant part of the presentation was devoted to communication issues. He pointed to the development of the Secure State Communication System based on the TETRA standard and the need to provide firefighters with reliable radio communication in hazard zones. He also presented a target model in which firefighters will be equipped with modern radio telephones serving as critical communication terminals, capable of cooperating both with the TETRA network and broadband networks (LTE, Wi-Fi), with automatic switching between systems.

In this context, he also discussed the development of location functions, including both satellite GNSS systems and indoor location technologies using beacons and Bluetooth. He emphasized that location data will be transmitted to the command post via various transmission channels, increasing reliability.

A key element of the presentation was the concept of the so-called “digital dog tag”, an integrated firefighter monitoring system. The speaker indicated that current solutions, such as PASS systems, are insufficient because they do not enable precise location tracking. The new approach assumes the use of data fusion from various sensors (including IMU and GNSS) and communication systems, enabling ongoing tracking of a firefighter’s position both outdoors and inside buildings.

He emphasized that this system, operating automatically, may serve as a “last line of defense,” transmitting information about a firefighter’s location to the command post and generating alarms in hazardous situations. Compared with traditional solutions, it enables visualization of position in 2D/3D space and remote support for the commander’s decisions.

In conclusion, the speaker stressed that the implementation of modern technologies in communication, location tracking, and firefighter monitoring is crucial for improving firefighter safety. These solutions are intended to increase situational awareness, shorten response times, and reduce the risk of loss of life and health during rescue operations.

A question from the audience concerned the possibility of using the discussed solution by Volunteer Fire Service units. The speaker emphasized that ultimately communication in the TETRA standard should be ensured for all firefighters—both State Fire Service personnel and volunteers.

During the discussion, attention was also drawn to the rationale for using modern technologies in situations where risk to firefighters is particularly high and operations can be conducted remotely. In this context, reference was made, among other things, to the use of sonars, rescue anchors, and robots, which allow the direct exposure of firefighters to be reduced.

“Dedicated solutions for the fire service – protective shields, airbag protection” – Łukasz Łaciok, Dexwal

The speaker presented two innovative solutions aimed at increasing firefighter safety during operational activities.

The first was a driver airbag restraint/protection device—a specialist cover mounted on the steering wheel, designed to reduce the effects of an uncontrolled airbag deployment during rescue operations inside a vehicle. The simplicity and speed of use were emphasized—the device can be installed in less than two seconds—as well as its functionality, including the possibility of immediately puncturing the airbag fabric thanks to built-in blades.

The second solution was a protective shield for firefighters, an advanced personal protection barrier designed to protect against high temperatures, the effects of sudden explosions, and fragments. The speaker noted that in many situations extreme conditions prevent safe access to the source of danger, and the use of the shield significantly increases the level of firefighter protection.

The presented device features a 4-in-1 hybrid design—it combines the function of a protective shield, a visor with a camera, a thermal imaging system, and a universal nozzle mount. This makes it possible to carry out extinguishing operations and observe the situation from behind the shield at the same time.

In conclusion, the speaker emphasized that implementing such solutions translates into both improved firefighter safety and increased operational effectiveness. They make it possible, among other things, to quickly locate heat sources and remotely transmit images to command posts, thereby supporting operational decision-making.

“The helmet of the future – the use of neuromuscular interfaces for touchless control in rescue operations” – Paweł Bujny, M.Sc. Eng. / Senior Brigadier Jacek Zboina, D.Sc. Eng., CNBOP-PIB

Paweł Bujny, M.Sc. Eng., head of the IT Department at CNBOP-PIB, discussed a presentation prepared by himself and Senior Brigadier Jacek Zboina, D.Sc. Eng. Deputy Director for Certification and Approvals, on the concept of the “helmet of the future.” The speaker presented four projects: Soteria (“Little Flame”), supporting the management of rescue operations using AI; Hercules, concerning touchless control; Dryad, an early forest fire detection system; and Hephaestus, integrating firefighters with automation and robotics.

The central element of the presentation was the Hercules project, whose goal is to shorten firefighter response times by enabling the control of devices without using hands. The speaker indicated that even simple activities, such as starting a vehicle fire pump, can take dozens of seconds, which is operationally significant during an incident.

The presented solution is based on a non-invasive system integrated with a firefighter helmet, which processes the user's bioelectrical signals in real time and translates them into specific commands controlling devices such as fire pumps, lighting, or robots. A key assumption is complete touchless operation—control is carried out using trained, discreet neuromuscular signals, such as jaw muscle tension.

The speaker emphasized that the system works on the basis of edge computing, meaning that signal analysis and interpretation are performed locally, without delays and without the need to use the cloud. An important element is also resistance to interference—artificial intelligence algorithms filter out accidental movements and signals resulting from stress or physical effort, recognizing only intentional commands.

He also pointed to the ergonomics of the solution—the sensors are miniaturized and integrated with the helmet in a way that does not affect its protective functions, and the entire system operates passively, without interfering with the firefighter's body. Communication between the helmet and devices is wireless, eliminating the risk of electric shock.

The speaker also discussed the development of the concept—from initial attempts to use cognitive signals to a more reliable hybrid model combining signals from the nervous and muscular systems. The use of mechanisms such as active intent verification, command confirmations, and time locks increases operational safety and reduces the risk of errors.

The system has already been tested in practice, including the control of a mobile robot that correctly interpreted commands generated by the operator. Further plans include expanded applications, comparative effectiveness studies (e.g. manual vs. "thought-based" control), and integration with additional rescue equipment.

In conclusion, the speaker emphasized that the development of this type of technology is a step toward increasing the effectiveness of rescue operations and reducing the burden on firefighters in situations requiring rapid decision-making and the simultaneous performance of many tasks..

“Invitation to cooperate with the CNBOP-PIB scientific club” – Paweł Bujny, M.Sc. Eng., CNBOP-PIB

Paweł Bujny introduced the audience to the Scientific Club established last year under the patronage of the CNBOP-PIB (Scientific and Research Centre – National Research Institute in Józefów).

It gathers Institute employees who wish to develop their professional competencies and interests in the fields of technical and social sciences. The scope of the Club's activities includes, on the one hand, work related to new technologies in fire protection, such as artificial intelligence, quantum computing, and robotics, and on the other hand, issues in the area of social sciences, in particular security studies.

The organization focuses on deepening knowledge beyond the standard scope of research conducted by CNBOP-PIB, carrying out research projects—often futuristic in nature—and organizing scientific meetings and workshops. The Scientific Club provides a space for presenting the results of members' own research, as well as a platform for cooperation and exchange of experience—both among members and with scientists and experts in the field of safety and fire protection. As the chairman, he warmly invited everyone to join these activities.

“360° imaging technology in firefighter protection and optimization of operational decisions (FirstLook 360)” – Senior Brigadier (ret.) Grzegorz Bugaj, Ph.D. Eng.

Senior Brigadier (ret.) Grzegorz Bugaj, Ph.D., presented the use of 360° spherical imaging technology (FirstLook 360) in rescue operations, with particular emphasis on operations conducted in wells and other hard-to-reach spaces.

The speaker pointed to the key challenge of effectively assessing a space using traditional cameras, which require maneuvering and do not provide a full picture of the situation. In response to these limitations, he presented a solution enabling the immediate acquisition of a full 360° view, allowing comprehensive assessment of an object, including, for example, inspection of the bottom of a well or rubble.

The presented device enables simultaneous recording of image and sound, real-time video transmission, and voice communication with persons located in the operational zone. The system also offers mapping functions, metadata recording (including GPS, time, and date), and cooperation with mobile devices via LTE or Wi-Fi. Thanks to its compact design, lack of moving parts, and capability for both wired and wireless operation, the solution is characterized by high reliability and ease of use in difficult operational conditions.

The speaker emphasized the main advantages of the technology, such as full spatial coverage without blind spots, immediate access to the image without the need for scanning, and the possibility of simultaneously sharing the image with several recipients, including the command post.

He also pointed out limitations of the solution, including image distortions characteristic of the “fisheye” effect and the need for appropriate user training in the interpretation of the obtained image.

In conclusion, he indicated that 360° imaging technology significantly increases firefighter safety by improving situation assessment and supports operational decision-making in real time..

“For firefighters without cancer – integrated operational hygiene after exposure to PAHs” – Łukasz Łaciok, Edufire

Łukasz Łaciok presented the issue of health hazards related to firefighter exposure to polycyclic aromatic hydrocarbons (PAHs). He indicated that firefighters belong to an occupational group at increased risk of developing cancer, including, among others, testicular cancer, mesothelioma, and skin cancer.

The speaker emphasized that effective health protection requires a comprehensive approach, including both the proper selection of protective clothing and appropriate procedures for its use and maintenance. He pointed out that despite the use of personal protective equipment, some contamination penetrates the skin—even up to 20% of contaminants present on the outer layer of clothing may be detected on the skin.

In this context, he discussed the importance of modern protective clothing solutions, pointing to examples of garments and equipment elements providing better sealing of vulnerable areas, such as the helmet-jacket connection, while maintaining appropriate ventilation, which reduces sweating and toxin absorption.

An important part of the presentation concerned skin decontamination. The speaker noted that the use of ordinary soap is insufficient and may even lead to damage to the skin's protective barrier and increased absorption of harmful substances. As a solution, he pointed to specialist decontamination products such as PAK-EX, developed in cooperation between scientists and firefighters, which effectively remove soot, PAHs, and smoke odor while protecting the skin.

In conclusion, the speaker emphasized the need to follow operational hygiene procedures, including a clear separation of clean and dirty zones, as a key element in reducing firefighter exposure to toxic substances and minimizing long-term health effects..

**“Decontamination of firefighters’ PPE – from water washing to LCO₂ technology” –
Brigadier (ret.) Tomasz Krasowski, M.Sc. Eng.**

Tomasz Krasowski presented the issue of firefighter personal protective equipment (PPE) decontamination from both a technological and a systemic perspective. He emphasized that effective protection of firefighters’ health requires moving away from a point-based approach toward comprehensive management of occupational exposure throughout the entire operational cycle—from the incident scene to the use and maintenance of clothing.

The speaker drew attention to the growing importance of so-called secondary exposure, resulting from contact with contaminated PPE, equipment, or fire station infrastructure. He indicated that protective clothing, in addition to its protective function, may act as a reservoir of toxic substances such as polycyclic aromatic hydrocarbons, heavy metals, and particulate matter, which are not always visible but are of significant health importance.

In this context, he discussed the limitations of traditional cleaning methods. Water washing, although effective in removing hydrophilic contaminants, has limited effectiveness against hydrophobic compounds, which often remain in the material structure even after repeated cleaning. In addition, it may lead to the gradual degradation of the clothing’s protective properties.

As an alternative, he presented liquid carbon dioxide (LCO₂) decontamination technology, which, thanks to different physicochemical properties, enables more effective reduction of selected groups of contaminants while preserving the material parameters of the clothing. He noted, however, that technology alone—even the most advanced—does not solve the problem of secondary exposure.

A key element of the presentation was the need to implement a coherent operational hygiene system. The speaker presented a model covering all stages of PPE functioning: activities at the incident scene, transport, organization of space at the station, clothing management, the decontamination process, as well as training and supervision. He emphasized that protection effectiveness depends on the tightness and coherence of the entire system, not on any single element.

In this context, he also referred to ISO 23616, which emphasizes management of the decontamination process—its validation, documentation, and effectiveness control—rather than indicating one specific technology.

In conclusion, the speaker emphasized that firefighters’ secondary exposure is a real, scientifically confirmed threat, and that reducing it requires combining effective decontamination technologies with a systemic approach to operational hygiene. He stressed that decontamination is a tool, while only a comprehensive management system allows for a lasting reduction in health risk.

4.1. Summary and conclusions from Session 4

Session 4 focused on solutions directly supporting firefighters in operational activities, showing that firefighter safety today requires the simultaneous development of technology, procedures, and occupational hygiene. Three main directions clearly emerged: improving firefighter communication and location tracking, developing tools that increase safety in hazard zones, and reducing the long-term health effects of service.

The need to build a modern firefighter monitoring system strongly resonated, including reliable communication, precise location tracking, and ongoing supervision of firefighter functional parameters. In this context, particular importance was attached to the concept of the “digital dog tag,” which is intended to increase commanders’ situational awareness and shorten response times in life-threatening situations. It was also emphasized that such solutions should ultimately cover not only the State Fire Service but also Volunteer Fire Service units.

Presentations on operational equipment showed that even relatively simple but well-designed devices can significantly improve firefighter safety. This applies both to protection against uncontrolled airbag deployment in vehicles and to shields protecting firefighters against temperature, fragments, and the effects of violent phenomena. At the same time, more advanced concepts were presented, such as a helmet using neuromuscular interfaces for touchless control, fitting into the broader trend of integrating the firefighter with automation, robotics, and operational support systems.

An important thread of the session also concerned operational reconnaissance and situation assessment. Technologies such as 360° imaging show that improving situational awareness can directly affect operational safety, especially in hard-to-reach and particularly dangerous spaces. At the same time, it was emphasized that effective use of such solutions requires proper user preparation and incorporation into command practice.

The third important area concerned firefighter health and the long-term effects of exposure to toxic substances. Presentations devoted to operational hygiene, skin decontamination, and PPE cleaning showed that the threat does not end when the operation is over. Increasing importance is being attached to secondary exposure resulting from contact with contaminated clothing, equipment, and infrastructure. It was emphasized that effective health protection requires not only new decontamination technologies but also a coherent organizational system covering the incident scene, transport, fire station, procedures for use, and supervision.

The entire session showed that the future of firefighter safety is based on integrating technologies supporting real-time operations with solutions reducing health risks in the longer term. Modern systems are intended to increase effectiveness, shorten response times, and reduce the burden on firefighters, but their value becomes visible only when they are embedded in a well-designed operational and organizational system.

5. Conference Conclusions

- Civil protection and firefighter safety require a systemic approach rather than isolated solutions.
- New technologies are indispensable, but their effectiveness depends on integration with procedures, infrastructure, planning, and user competencies.
- Protective structures, warning systems, communication, rescue equipment, and support technologies should be designed as elements of a coherent safety ecosystem.

- It is crucial to link spatial planning with crisis management and civil protection already at the stage of preparing planning documents.
- Clear national guidelines and verification mechanisms are needed for new solutions, especially in the areas of protective structures, emergency communication, and energy storage systems.
- Technological development must go hand in hand with research, validation, certification, and assessment of the durability and reliability of solutions throughout their life cycle.
- Drones, AI, voice communication systems, 360° imaging, firefighter location tracking and monitoring already have real operational value today, but they should be implemented as part of a broader system.
- Artificial intelligence and automation should support humans, not replace them; the final decisions must remain with the commander or operator.
- An effective warning and alerting system should be multi-channel, redundant, and resilient to disruptions, while also being understandable to users.
- Traditional solutions such as warning sirens are still needed and should be complemented by modern communication channels.
- Public education, building social resilience, and preparing citizens to respond appropriately to threats play an important role.
- Local government units are becoming an increasingly important part of the local safety system and should be strengthened organizationally, in terms of competencies, and technologically.
- Firefighter safety requires improved communication, location tracking, monitoring of vital signs, and the development of solutions reducing direct exposure to hazards.
- Remote and semi-autonomous technologies are becoming increasingly important, allowing reconnaissance or operations to be carried out without exposing firefighters.
- Firefighters' health protection does not end at the incident scene; secondary exposure to contaminants is a real occupational hazard.
- PPE decontamination and operational hygiene should be treated as elements of a comprehensive firefighter health protection system, not as a single post-incident activity.
- In the case of new energy technologies, especially energy storage systems, further research, design guidelines, and solutions combining passive and active protection are necessary.
- Human competencies remain a condition for the effectiveness of the entire system—well-prepared designers, installers, operators, firefighters, and decision-makers are needed.
- Certification of competencies and the development of professional qualifications are essential for the safe implementation of new solutions.
- The foundation of an effective safety system remains cooperation—between science, practice, administration, industry, and end users.

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