



CNBOP-PIB

Report on the 5th International Scientific Conference

Safety of New Technologies



Patronage:



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1. General information

Organiser: Centrum Naukowo-Badawcze Ochrony Przeciwpowazarowej im. Józefa Tuliszkowskiego – Państwowy Instytut Badawczy (CNBOP-PIB) w Józefowie.

Co-organisers:

- ❖ Fire University (Akademia Pożarnicza)
- ❖ WSB University in Dąbrowa Górnicza
- ❖ Faculty of Mechatronics, Armament and Aviation, Military University of Technology
- ❖ Institute for Fire and Rescue Technology (IFR), Dortmund Fire Department
- ❖ Provincial Headquarters of the State Fire Service in Warsaw
- ❖ District Headquarters of the State Fire Service in Otwock
- ❖ School of Aspirants of the State Fire Service in Poznań
- ❖ PZU LAB SA
- ❖ European Fire Safety Alliance
- ❖ Polish Association of Fire Protection and Rescue Equipment Manufacturers
- ❖ Polish Energy Storage Chamber PIME
- ❖ Polish New Mobility Association
- ❖ Polish Energy Storage Association
- ❖ Association of Fire Engineers and Technicians

Honorary patronage:

- ❖ Chief Commander of the State Fire Service
- ❖ "Safety & Fire Technology"

Data konferencji: 25 September 2025

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Chairman of the scientific committee: st. bryg. Jacek Zboina, D.Sc. Eng.

Members of the Organization Committee: Katarzyna Szulejewska, M.A., Aleksandra Grzęda, M.A., Anna Golińska, M.A, Elżbieta Muszyńska-Poleć, M.A., Katarzyna Gromadka, M.A., Magdalena Szelling, M.A., Jarosław Tępiński, Ph.D. Eng., Michał Chmiel, , Ph.D. Eng., Marta Iwańska, M.A., Michał Pietrzak, M.Sc. Eng.

Chairman of the organization committee: Ilona Masna, M.A.

2. Purpose of the conference

The 5th International Scientific Conference was devoted to broadly understood security of new technologies, electromobility, and energy storage systems. The programme included expert presentations and discussions fostering the formulation of conclusions, identification of needs, and proposals for measures aimed at reducing fire hazards caused by electric batteries used in devices, electric vehicles, and renewable energy installations. The conference was addressed to manufacturers, designers, installers, officers and civilian employees of the State Fire Service, fire safety experts, building managers and owners, risk engineers, insurance brokers, and other specialists.

The detailed thematic scope of the conference included the following topics:

- ❖ Batteries, electric vehicles, photovoltaic installations – safety research
- ❖ Fire hazards of batteries and energy storage systems
- ❖ New technologies in the context of law, safety, and trust
- ❖ Robotics and artificial intelligence – opportunities and risks

3. Course of the conference

The scientific conference organized by CNBOP-PIB was divided into four sessions:

Session 1. New Technologies and Their Safety – Introduction to the conference topics – Conclusions and recommendations; Security of New Technologies – scientific and expert foundations (Panel discussion).

Session 2. Safety of New Technologies – Electromobility – Results of intersectoral cooperation; Guidelines, publications, training; Opportunities and barriers in the development of electromobility.

Session 3. Safety of New Technologies – Energy Storage – Opportunities and barriers in the development of energy storage; Fire safety guidelines for energy storage systems – update on the progress of work; Types of safety systems used in industrial energy storage facilities; Fire safety research on energy storage systems – research findings.

Session 4. New Technologies for Safety – The use of artificial intelligence in safety research; Fire safety – new threats = new solutions; How to recognize synthetic content? A set of deepfake characteristics for information security.

3.1. Session 1. New Technologies and Their Safety

During the first session, moderated by prof. Anna Rabajczyk, conclusions and recommendations from previous conferences in the Safety of New Technologies series were presented, and a panel discussion was conducted on the scientific and expert foundations of new technology security.

The panel discussion participants included:

- ❖ Barbara Adamska, President of PSME
- ❖ Dariusz Gołębiewski, Vice President of the Management Board of PZU LAB SA
- ❖ Senior Brigadier Prof. Paweł Janik, Ph.D., D.Sc., Eng., Director of CNBOP-PIB
- ❖ Artur Łasak, Sales Director, DEHN Polska

During the discussion, numerous issues related to the security of new technologies were addressed, particularly in the context of electromobility and energy storage systems. Below is a summary of the topics discussed and the conclusions drawn from the panel discussion.

- **Energy Storage Systems and Technical Risk**

During the discussion, experts exchanged views in particular on the opportunities, needs, and risks associated with the widespread use of energy storage systems, especially in the context of fire safety. The experience of the German market was cited as an example, where nearly 2 million residential energy storage systems are already in operation. The potential hazards posed by energy storage systems in residential applications may be compared, for example, to those associated with solid-fuel boilers, which are statistically recorded as a cause of fires.

Considering the physical properties of lithium-ion batteries and the potential hazards related to their operation under failure conditions, all specific risks must be taken into account in the practical use of energy storage systems. These include the possibility of explosive atmospheres forming indoors due to the release of hydrogen, hydrocarbons, and toxic gases.

It is essential that this risk be analysed comprehensively, encompassing both its minimisation and the mitigation of its consequences through the application of appropriate fire protection measures – both organisational and technical.

- **Cybersecurity**

Cybersecurity is a key issue within the broadly understood concept of safety, particularly in the context of integrating all new technologies across various applications. For example, the energy infrastructure in our country is exposed to daily cyberattacks, and every connected device (such as an energy storage system or inverter) may constitute a potential entry point to the system. Gaining control over an energy storage system may lead not only to disruptions within the unit itself, but also to serious disturbances across the entire network, including a blackout.

- **Fire Protection for Batteries and Energy Storage Systems.**

It was emphasized that every new technology, including the various discussed applications of lithium-ion batteries, should be analyzed in the context of the potential hazards they may pose in specific areas of use. According to research conducted by CNBOP-PIB, one of the most important factors for fire safety when lithium-ion batteries are used indoors is proper ventilation. This is particularly significant in the context of Polish construction practices, where residential rooms (with the exception of bathrooms and kitchens) are generally not ventilated. In the case of containerized energy storage systems, it is also crucial to maintain appropriate distances between containers and other building structures in order to limit potential fire losses to a single container. Attention was also drawn to the problem of the lack of tested and certified fire detection and control systems dedicated to the fire protection of energy storage systems. Existing and currently offered solutions (for example, gas-based or aerosol systems) do not have confirmed effectiveness in extinguishing battery fires in this specific application. Therefore, research and testing in this area are necessary. They will enable the responsible selection, design, and operation of detection, control, and fire suppression systems.

- **Market Differences (Poland vs. Germany)**

In Poland, there is a problem of choosing cheaper and unverified “DIY” solutions instead of integrated and authorized systems. This results from the dominance of price as the primary criterion in public tenders and among individual investors. In Germany, installers demonstrate greater caution and assume greater responsibility for the quality of installation and for ensuring that productivity forecasts correspond to actual performance. As a result, they are less likely to offer unproven solutions. In Poland, the need to implement holistic lightning and surge protection is also frequently ignored, which is a consequence of taking “shortcuts” and focusing on cost optimization.

- **The Role of the Insurance and Financial Market**

Insurance companies act as risk experts, and their role in the market should be based on having the best knowledge of potential hazards and ways to manage them. Risk analysis makes it possible to assess the safety of a given technology, and the insurance premium should serve as an incentive to invest in safety measures or even to withdraw coverage for high-risk solutions. Banks and financing institutions should influence investors by accepting only those solutions that are safe. In Poland, no spectacular incidents caused by new technologies have been recorded so far; however, many potential hazards have been identified, for example those resulting from improperly installed and aging systems, such as photovoltaic installations.

Formulated Conclusions:

- ❖ **Education and Awareness:** Effective measures should be undertaken to educate and raise awareness among end users, investors, and managers regarding the selection of manufacturers and installers, as well as methods for mitigating the risks associated with cheap and unverified solutions.
- ❖ **Standards and Certification:** The market for new technologies remains an “experimental area,” and legal regulations do not keep pace with ongoing changes. There is also no basis to claim that this situation has

improved. From a fire safety perspective, it is crucial to ensure solutions for which fire risk has been validated, real hazards have been assessed, and appropriate measures have been implemented to minimize the risk or reduce it to an acceptable level. Control of product performance through conformity assessment by an independent third party plays a decisive role in ensuring fire safety. Beyond legal regulations and product certification, ensuring fire safety also requires detailed technical standards, guidelines, and best practices developed through cooperation between the fire protection sector, the technology industry, and the insurance sector.

- ❖ **Holistic Protection:** Appropriately selected and available protective technologies should be implemented, such as hazard prediction systems, smoke/heat detectors, battery cell monitoring systems, fire control and suppression systems, as well as proper lightning and surge protection. These constitute the fundamental elements of protection.
- ❖ **Cooperation and Testing:** Cooperation and open discussion of risks in connection with technical protection solutions and systems were encouraged. The most important recommendation is the urgent need to conduct research and testing of fire protection systems dedicated to energy storage facilities.
- ❖ **Costs vs. Safety:** Safety must not be compromised for the sake of cost savings. Responsible and rational decision-making is essential in this regard. Choosing the cheapest, unverified solutions carries the risk of very high costs—both material losses and threats to the life and health of users and emergency responders.

3.2. Second Session – Safety of New Technologies: Electromobility

During the second session, moderated by Jarosław Tępiński, Ph.D. Eng. the following issues were addressed:

- 1) The results of cross-sector cooperation for safety – guidelines, publications, training – Elżbieta Muszyńska-Poleć, CNBOP-PIB,
- 2) Opportunities vs. barriers in the development of electromobility – Albert Kania, PSNM.

3.2.1. Results of Cross-Sector Cooperation – Guidelines, Publications, Training

Ms. Elżbieta Muszyńska-Poleć presented a comprehensive summary of the most significant outcomes of inter-institutional cooperation carried out between 2022 and 2025 among the Scientific and Research Centre for Fire Protection – National Research Institute (CNBOP-PIB), the Polish New Mobility Association (PSNM), and the National Headquarters of the State Fire Service (KG PSP). The main objectives of these initiatives were to develop recommendations regarding fire protection conditions in garages intended for charging electric vehicles, to educate rescue service representatives involved in operations with electric vehicles (EVs), and to disseminate reliable and verified information based on scientific research.

As a result of this cooperation, a comprehensive set of materials was developed, forming a foundation of knowledge and procedures for both the rescue community and designers. The first key achievement is the document Standard Operating Procedures for Incidents Involving Electric and Hybrid Vehicles (No. SZP 4), the second edition of which was published in May 2023. The document aims to systematize knowledge regarding rescue operations involving

electric and hybrid vehicles. These procedures are intended to support the Incident Commander and cover activities ranging from initial assessment and scene safety measures to rescue operations in the event of a traffic accident or fire, and the handover of the incident site. It should be emphasized that the overriding principle formulated in the document is the safety of rescuers, taking into account the risk of sudden battery ignition during operations.

The second significant outcome of the Institute's cross-sector cooperation is an e-guide for firefighters entitled *Conducting Rescue Operations During Incidents Involving Electric Vehicles*. The publication has attracted considerable interest, with 2,400 downloads recorded. The guide covers detailed topics such as definitions, characteristics of electric drive systems, descriptions of charging stations and charging points, principles for hazard identification, procedures for conducting rescue operations in various scenarios, as well as important issues related to post-fire water retention and safe operational practices for rescuers.

The third achievement is *the Guidelines for Fire Protection in Garages within Buildings Intended for Charging Electric and Plug-in Hybrid Vehicles*. This document was published in a circulation of over 1,000 copies. The guidelines constitute a comprehensive source of knowledge for designers and facility managers, addressing in detail, among other aspects, technical and construction conditions of garages, requirements for ensuring appropriate conditions for rescue and firefighting operations, hazard identification and assessment, key factors influencing fire safety, as well as certification of fire protection conditions and competencies in design. These guidelines were complemented by the development and implementation of dedicated training for rescuers. The training was divided into a theoretical part, focusing on the characteristics of electric vehicles and batteries and associated electrical hazards such as manufacturing defects or short circuits, and a practical part presenting a dialogue between a firefighter and an automotive and vehicle mechanics specialist, based on the Standard Operating Procedures scenario.

The conclusions drawn from the presented cooperation outcomes are clear: the implemented projects constitute an effective and comprehensive response to new challenges in fire safety and rescue operations related to the development of electromobility in Poland. The development of both standard operating procedures for emergency services and detailed guidelines for designers and facility managers establishes a unified, research-based operational standard. The broad educational reach, confirmed by the number of downloads and views, demonstrates that a significant knowledge gap has been addressed and that the delivered content is of high quality.

3.2.2. Opportunities vs. Barriers in the Development of Electromobility

Mr. Albert Kania's presentation entitled "Opportunities vs. Barriers in the Development of Electromobility" provided a comprehensive analysis of the arguments supporting the transformation of transport towards electric mobility. The speaker identified the key challenges currently facing this sector. It was emphasized that electromobility is not merely a trend, but above all a necessity in light of global and local challenges. The primary justification for transport electrification is climate protection. Transport accounts for approximately 22% of global greenhouse gas emissions, and in the European Union, road transport represents as much as 72% of emissions within the entire transport

sector, of which 43.5% is attributable to passenger cars. The second key factor is public health protection, understood as combating air pollution. In Poland in 2022, transport was responsible for significant shares of nitrogen oxide emissions (32.91%) and soot (26.74%). Additionally, electromobility represents an opportunity to strengthen Poland's energy security by reducing dependence on crude oil imports, which accounted for 98.6% of supply in 2024, while the country remains self-sufficient in electricity production. The annual electricity consumption of one million electric vehicles would account for only about 1% of national electricity production. Finally, electromobility is an essential element of economic competitiveness and innovation, driving the development of advanced technologies, enabling the modernization of the automotive industry, and generating new jobs, as evidenced by the global investment value in this sector reaching USD 757 billion in 2024.

In conclusion, it was noted that despite strong environmental, health, and economic arguments in favor of electromobility, key challenges—particularly related to infrastructure and pricing—remain the main barriers that the sector must overcome. Nevertheless, thanks to an increasingly broad model offering, pricing adjustments, and the commissioning of numerous infrastructure investments, gradual market maturation can be expected, albeit with the continued need to address regulatory and technological obstacles.

3.3. Third Session – Safety of New Technologies: Energy Storage

During the third session, moderated by M.Sc. Eng. Michał Pietrzak, the following issues were addressed:

- 1) Opportunities and barriers in the development of energy storage – Barbara Adamska, PSME,
- 2) Guidelines on fire safety for energy storage systems – update on the status of work – Jarosław Tępiński, Ph.D. Eng, CNBOP-PIB,
- 3) Types of safety systems used in industrial energy storage facilities – Krzysztof Bukala, SOLFINITY,
- 4) Fire safety testing of energy storage systems – research findings – Brig. Wojciech Klapsa, M.Sc. Eng. CNBOP-PIB.

3.3.1. Opportunities and Barriers in the Development of Energy Storage

The presentation delivered by Ms. Barbara Adamska, President of the Management Board of the Polish Energy Storage Association (PESA/PSME), focused on the strategic role of energy storage systems in the transformation of Poland's energy sector and on identifying key legislative and technical obstacles hindering the full realization of this potential.

The mission of PSME is to actively support the transformation of the Polish energy sector and economy. The Association recognizes energy storage systems as an essential component in building a modern energy system and a low-emission economy. It pursues its objectives by integrating stakeholders and professional communities, working within advisory teams, preparing analyses and reports for government institutions, and conducting educational and informational activities. An important element of its work is also the promotion of safety standards related to the operation of energy storage systems.

The presented material highlighted gaps in the current regulatory environment. It was stated that the existing Polish legal framework is not fully sufficient to create effective business models for the application of electricity and heat storage systems, nor to integrate them into market mechanisms that would stimulate the development of distributed and renewable energy.

The subsequent part of the presentation focused on detailed technical and formal regulations that currently determine the feasibility of investment projects. A detailed classification of battery storage systems based on capacity was introduced, directly affecting required administrative procedures and fire safety requirements.

Very small storage systems (up to 30 kWh) are exempt from formal procedures.

Small storage systems (up to 120 kWh when installed inside a building and up to 300 kWh as standalone units) require approval from the State Fire Service (PSP).

Medium storage systems (up to 300 kWh when installed inside a building and up to 4,000 kWh as standalone units) require both approval from the State Fire Service (PSP) and a construction notification.

Large storage systems (above 300 kWh when installed inside a building and above 4,000 kWh as standalone units) require not only approval from the State Fire Service but also a building permit.

During the presentation, it was identified that storage systems located inside buildings pose an increased risk to people, property, and emergency services. Their implementation therefore requires careful design, individual adaptation to the building's conditions, and a qualified installation team.

The conclusions drawn from the presented material indicate that the Polish energy storage market is undergoing intensive technical development; however, its full implementation faces significant legal and formal constraints. It is crucial to adapt the legal framework to the growing needs of the market and to harmonize and streamline procedures, particularly in the context of fire safety..

3.3.2. Guidelines on Fire Safety for Energy Storage Systems – Update on the Status of Work

Jarosław Tępiński's presentation provided a summary of the current status and scope of work on the guidelines concerning fire safety for energy storage systems. In view of the intensive development of the energy storage market and the urgent need to define fire protection conditions and the safe operation of electrochemical storage systems, cooperation was initiated in August 2024 to develop a document entitled Guidelines on Fire Protection Conditions for Energy Storage Systems.

The scope of the ongoing work reflects broad cooperation among specialists from various fields, including collaboration between the Scientific and Research Centre for Fire Protection – National Research Institute

(CNBOP-PIB), the Polish Chamber of Energy Storage and Electromobility, the Association of Fire Engineers and Technicians, and the Polish Energy Storage Association.

The main scope of the developed guidelines includes an analysis of fire protection requirements for currently used electrochemical battery technologies and for various storage locations (both standalone installations and those located within buildings). It was indicated that the most important factors enabling effective rescue and firefighting operations during a fire involving an electrochemical energy storage system are: early fire detection and notification of the fire service, interruption of the battery heating process, effective ventilation of the room, and control of fire spread until emergency response teams arrive.

In conclusion, it was emphasized that there is an urgent need to establish coherent guidelines which, based on scientific research, expert experience, and the standardization achievements of other countries, will propose national standards for fire protection in the dynamically developing energy storage sector. The guidelines under development are intended to serve as a comprehensive source of knowledge, integrating fire safety, technical, and industry expertise, with a focus on active hazard control methods such as early detection, monitoring, effective fire suppression, and ventilation—measures that are essential to minimizing the risks associated with energy storage fires..

3.3.3. Types of Safety Systems Used in Industrial Energy Storage Facilities

The presentation delivered by Mr. Krzysztof Bukala, ESS Project Development Manager, focused on safety components and structural solutions applied in industrial energy storage systems, with particular emphasis on outdoor cabinet-based systems. Various types of protection measures essential for ensuring the reliable and safe operation of these storage systems were also discussed.

A key part of the presentation was a detailed overview of the three-level protection concept used in energy storage systems, which includes:

1. **Cell Level:** A layer of protection safeguarding each individual cell against the most common failures, such as overvoltage and undervoltage, short circuits, overloads, and excessive internal pressure that may lead to vent activation.
2. **Module Level – BMS (Battery Management System):** The next layer of control operating at the battery module level. In addition to voltage and short-circuit monitoring, a critical function at this level is the prevention of thermal runaway.
3. **Preventive and Incident Protection Level:** A safety layer encompassing detection systems (temperature, humidity, smoke, insulation/leakage current) as well as fire protection systems. In the case of outdoor systems, cabinet structures often provide fire resistance rated at class R240, meaning they maintain structural integrity for four hours.

In the concluding remarks, it was emphasized that the effective implementation of energy storage systems requires not only high-quality components but, above all, advanced safety engineering integrated throughout all stages of operation..

3.3.4. Fire Safety Testing of Energy Storage Systems – Research Findings

The presentation delivered by Brig. M.Sc. Eng. Wojciech Klapsa from the Laboratory Team for Combustion and Explosion Processes at CNBOP-PIB focused on the key role of testing in the context of fire safety for energy storage systems and provided information from research on thermal and gas-related phenomena accompanying energy storage fires.

The speaker referred to Regulation (EU) 2023/1542 of the European Parliament and of the Council, which as of 18 August 2024 obliges manufacturers to prepare technical documentation containing evidence that batteries have been tested with regard to the safety parameters specified in Annex V, as well as an assessment of potential hazards not covered by that Annex. This introduction clearly emphasized that testing is synonymous with safety and has become a legal requirement within the European Union.

It was noted that the CNBOP-PIB laboratory conducts detailed tests aimed at characterizing battery fires and the associated hazards. The main research objectives included the collection of measurement data using laboratory equipment, including 32 temperature measurement points (type K thermocouples up to 1100°C), a thermal imaging camera, light transmittance sensors, heat radiation sensors (four sensors with different measurement ranges), and specialized gas sensors.

The results of the tests conducted to date have provided valuable information on the dynamics of the hazards involved. With regard to smoke production, light transmittance versus time graphs were presented, enabling the determination of the rate and intensity of smoke emission. The conclusions drawn from CNBOP-PIB's research support the following statements concerning the fire safety of energy storage systems:

1. The risk associated with lithium-ion cell fires is multifaceted and includes not only high temperatures but also the rapid release and potential ignition of toxic gases.
2. These phenomena create specific, dynamic hazards to structures, infrastructure, and emergency response teams.

In conclusion, Brig. Wojciech Klapsa, M.Sc. Eng., emphasized that only reliable research makes it possible to understand and effectively manage the new hazards associated with energy storage technologies.

3.4. Fourth Session – New Technologies for Safety

During the fourth session, moderated by Senior Brig. Prof. Dr. Eng. Jacek Zboina, the following presentations were delivered:

- 1) The Use of Artificial Intelligence in Safety Research –Paweł Bujny, M.A., Senior Brig. Jacek Zboina, D.Sc. Eng., CNBOP-PIB,
- 2) Fire Safety – New Threats = New Solutions – Jarosław Wiche, Neuron,
- 3) How to Recognize Synthetic Content? A Set of Deepfake Characteristics for Information Security – Karol Jędrasiak, Ph.D. Eng., WSB University.

3.4.1. The Use of Artificial Intelligence in Safety Research

The presentation by Paweł Bujny, M.A., and Senior Brig. Jacek Zboina, D.Sc. Eng., focused on the growing role of artificial intelligence (AI) in the fire protection sector. Both global examples of its application and its potential for the Polish fire service were presented, including the unique firefighter assistant project – “Płomyczek.”

The material demonstrates that AI is no longer merely theoretical but has become a practical tool revolutionizing fire prevention and response. International examples illustrate this trend: in California (USA), AI systems such as IBM Watson analyze weather data, vegetation conditions, and historical fire patterns to predict wildfire risks. This enables targeted forest management and the construction of firebreaks, one of the most important preventive measures. In Australia, the National Bureau of Meteorology uses AI algorithms to analyze satellite and ground sensor data for early wildfire detection and real-time firefighter notification, significantly reducing response times. In Spain, the “FireWatch” project has been implemented, using AI technologies to monitor and analyze threats. It was emphasized that AI can analyze vast amounts of data in a very short time, which is beyond human capability.

Additionally, the “Płomyczek – Firefighter Assistant” project was presented as an example of AI supporting traditional firefighting services. Its potential benefits are multifaceted. “Płomyczek” may contribute to faster decision-making and improved rescue planning through rapid situation analysis. Importantly, AI can enhance firefighter safety by identifying potential hazards and developing the safest operational strategies. Such systems also have potential in education and training, transferring knowledge and skills to new firefighters and raising the overall qualifications of the firefighting community. In the future, AI may even provide emotional support in stressful or traumatic situations.

The presenters concluded that implementing AI in fire protection is inevitable. It offers vast potential in prevention, detection, and rescue operation management. Projects like “Płomyczek” demonstrate that AI can function as an effective assistant that strengthens—not replaces—traditional firefighter skills by providing informational advantage at critical moments. Effective implementation of AI, both globally and locally, will be decisive for improving rescue efficiency, increasing personnel safety, and supporting the development of the firefighting community in a modern technological environment.

3.4.2. Fire Safety – New Threats = New Solutions

Jaroslav Wiche (NEURON Group) focused on identifying new fire safety threats and solutions arising from modern technological development, particularly in the context of electric vehicles (EVs) and battery energy storage systems (BESS). Innovative solutions for managing these risks were presented.

It was emphasized that new technologies, while representing progress, simultaneously introduce new, specific fire safety risks requiring new technical solutions. Energy storage systems, electric vehicles, reactive power compensation capacitors, server rooms, and UPS systems with lithium-ion batteries are currently major sources of such risks.

In the case of EVs, underground garage fires present significant challenges. The example of a Volkswagen ID.4 fire in an underground garage in Warsaw—where firefighters extinguished and cooled the battery for over an hour—clearly illustrated these difficulties, particularly regarding ventilation and evacuation in heavily smoke-filled conditions.

To address these threats, advanced detection and suppression systems are necessary. Early warning solutions capable of detecting elevated temperatures before open flames or dense smoke appear are essential. An innovative solution, i-Sprink, was presented as an effective adaptation of established technology.

The conclusions indicate that the development of electromobility and energy storage creates new, critical fire safety challenges that cannot be effectively managed using conventional methods. Early and precise thermal detection enabling identification of threats in the pre-fire phase is a key element of safety strategy for lithium-ion batteries. The effective implementation of modern technologies—such as intelligent thermal imaging cameras and certified, innovative fire suppression systems—is essential to minimize risks and protect people and property..

3.4.3. How to Recognize Synthetic Content? Deepfake Characteristics for Information Security

Karol Jędrasiak, Ph.D. Eng., focused on the rapid development of technologies for generating and modifying digital content, particularly deepfake phenomena, and the challenges of detecting them in the context of information security.

The presentation demonstrated how easily AI tools can manipulate images, facial expressions, and even perform “emotion transplants” from one video sequence to another. These technologies enable modification of facial images, body movements, and voice. Such broad manipulation capabilities lead to deepfake phenomena, including fake video, fake audio, and hybrid combinations such as fake video with real audio, real video with fake audio, or partially authentic content mixing real and false elements.

The spread of synthetic content has serious consequences: mockery, insult, manipulation, data extraction, incitement, and blackmail. These threats exist both at the individual and societal level, where millions of AI bots can monitor and influence public sentiment.

Although deepfakes are becoming increasingly sophisticated, defensive measures still exist: fact-checking, watermarking, and detection tools. However, watermarks and detection systems can be bypassed, and fact-checking is time-consuming. The most important—and most difficult—defensive measure is public education. Users should avoid sharing false content, report it, and explain digital manipulation to others. Education and responsible user behavior remain the key to maintaining information security..

3.5. Theses and Conclusions

During each conference session, key theses and conclusions were formulated based on presentations, panel discussions, and case studies. These form the foundation for further expert, legislative, and implementation work at national and international levels.

The main conclusions include:

- 1) **Education and Awareness:** Effective actions should be taken to educate and raise awareness among end users, investors, and managers regarding the selection of manufacturers and installers, as well as measures to eliminate the hazards posed by cheap, unverified solutions.
- 2) **Standards and Certification:** The market for new technologies is an “experimental area,” and legal regulations do not keep pace with change. There is no basis to claim that this situation has improved. Moreover, for fire safety it is crucial to ensure solutions for which fire risk has been validated, real hazards have been assessed, and appropriate measures have been applied to minimize that risk or reduce it to an acceptable level. A key factor in achieving fire safety is control of product characteristics through conformity assessment by an independent third party. In addition to legal regulations and product certification, ensuring fire safety requires detailed technical standards, guidelines, and best practices developed through cooperation between the fire protection, technology, and insurance sectors.
- 3) **Holistic Protection:** Appropriately selected, available protective technologies should be used, such as hazard prediction systems, smoke/heat detectors, systems monitoring cell condition, control and suppression systems, as well as proper lightning and surge protection. These are the basic elements of protection.
- 4) **Cooperation and Testing:** Cooperation and open discussion of hazards in connection with solutions and technical protection systems were encouraged. The most important recommendation is the urgent need to undertake research and testing of fire protection systems dedicated to energy storage facilities.
- 5) **Costs vs. Safety:** Safety must not be compromised to save costs. Responsible and rational decision-making is necessary in this area. Choosing the cheapest, unverified solutions entails the risk of very high costs—losses both material and those related to threats to the life and health of users and emergency responders.

6) **Results and the Need for Effective Cross-Sector Cooperation:** The tangible and unique cross-sector results—between fire protection and technology industries—confirm the validity of the initiatives undertaken and implemented and justify the need to continue them in response to new hazards and technology deployments.

7) **Electromobility:** Key challenges related to infrastructure and pricing remain the greatest barriers the sector must overcome. Thanks to an increasingly broad range of models, price changes, and the commissioning of numerous infrastructure investments, gradual market maturation can be expected, although continuous efforts will be needed to overcome regulatory and technological barriers.

Furthermore, the implemented projects (discussed during the conference) constitute a comprehensive response to new challenges in fire safety and rescue operations associated with the development of electromobility in Poland. The development of both standard operating procedures for services and detailed guidelines for designers and facility managers establishes a unified, research-based operational standard. The broad educational reach, confirmed by the number of downloads and views, indicates that an important knowledge gap has been addressed and that the content provided is of high quality.

8) **Energy Storage Market in Poland:** The Polish energy storage market is undergoing intensive technical development, but its full deployment faces significant legal and formal constraints. It is therefore crucial to adapt the legal framework to the growing needs of the market and to harmonize and streamline procedures, particularly in the context of fire safety.

9) **Implementation Requirements:** Deploying energy storage technologies requires not only high-quality components, but above all advanced safety engineering integrated throughout all stages of operation.

10) **Guidelines and Their “Role”:** There is an urgent need to develop coherent guidelines which, based on scientific research, expert experience, and the standardization achievements of other countries, will propose national fire protection standards for the dynamically developing energy storage sector. The guidelines currently under development are intended to be a comprehensive source of knowledge, combining fire safety, technical, and industry expertise, and focusing on active hazard control methods such as early detection, monitoring, effective suppression, and ventilation—measures essential to minimizing risk in the event of energy storage fires.

11) **Research for Safety:** For nearly 10 years, CNBOP-PIB has been conducting detailed research and tests aimed at characterizing battery fires and the hazards accompanying them. Extensive measurement data and research results have been collected using specialized laboratory equipment, including 32 temperature measurement points, a thermal imaging camera, light transmittance sensors, heat radiation sensors, and specialized gas sensors. CNBOP-PIB's findings on the fire safety of energy storage systems confirm that the risk associated with lithium-ion cell fires is multifaceted and includes not only high temperatures but also the sudden release and potential ignition of toxic gases. These phenomena create specific, dynamic hazards to

structures, infrastructure, and emergency response teams. Only reliable research makes it possible to understand and effectively manage the new hazards associated with energy storage technologies.

- 12) **New Challenges Require Modern Solutions:** The development of technologies such as electromobility and energy storage creates new, critical fire safety challenges that cannot be effectively managed using conventional methods. Effective implementation of modern fire protection technologies—such as dedicated early detection systems, intelligent thermal imaging cameras, and certified, innovative suppression systems—is essential to minimize risk and ensure protection of people and property.
- 13) **AI Potential:** Implementing AI-based systems is inevitable in the fire protection sector. This technology can analyze enormous amounts of data in a very short time, which may affect how we perceive fire prevention and response. The presented examples allow the conclusion that implemented solutions should function, for example, as an effective assistant (the “Płomyczek” project) that enhances rather than replaces traditional firefighter skills, improving their safety and operational effectiveness. Effective AI implementation, both globally and locally, will have a decisive impact on rescue efficiency, personnel safety, and the development of the firefighting community in a modern technological environment.
- 14) **Deepfake Threats and Information Security:** In view of the rapid development of technologies for generating and modifying digital content (deepfakes), public education and conscious, responsible user behavior are necessary. This is the most difficult, yet key, defense measure against disinformation.

3.6. Closing and Conference Summary

Although the dynamic development of new technologies is inevitable and forms the foundation of the future, the key message of the 5th International Scientific Conference “Safety of New Technologies” is that innovation must go hand in hand with a holistic and uncompromising approach to safety.

Scientific findings, market experience, and expert discussions clearly demonstrated that fear of novelty must not hinder progress, but cost optimization must not outweigh risk considerations. There is an urgent need to harmonize and clarify legal regulations, particularly regarding energy storage.

It was emphasized that in Poland—unlike in more regulated markets—shortcuts are often accepted, including neglecting certified solutions, integrated surge protection, and the crucial role of early detection, control, suppression systems, and ventilation.

Education and awareness must be strengthened. Continued research and testing of lithium-ion battery fire protection systems and rescue technologies remain essential.

The future is based on technology, but its stability and social acceptance depend on shared responsibility for safety—technical, cyber, and informational. Scientific institutions, industry, insurers, and fire services must

cooperate intensively so that high-quality solutions become the first choice, and the phrase “safety costs” is replaced by the awareness that the lack of safety costs far more.

The conference organizer expresses gratitude to all co-organizers and participants and hopes that future CNBOP-PIB initiatives under the “Safety of New Technologies” series will receive equally strong engagement and constructive outcomes as the BNT V conference.

Chairman of the Scientific Committee of the Conference
Senior Brig. Jacek Zboina, D.Sc. Eng.