WATER MIST AND EVOLVING RISKS

The International Water Mist Association explains how water mist systems are advancing through targeted fire testing, demonstrating adaptability and efficiency across emerging risks

Over the past three decades, water mist technology has developed into one of the most versatile and efficient fire protection solutions available. Its ability to deliver high suppression performance with minimal water usage has made it suitable across a wide range of applications, from commercial kitchens to tunnels, buildings, transportation systems, industrial facilities and increasingly complex infrastructure environments.

A defining feature of water mist systems is their performance-based nature. Unlike more prescriptive technologies, water mist solutions are typically validated through fire testing tailored to specific applications. This has driven an exceptional level of research and development within the industry. In many sectors, including marine, tunnel and special hazard protection, large-scale fire testing programmes have been led by water mist manufacturers and research organisations.

While standards such as the EN 14972 series have matured significantly and now cover many common applications, the pace of technological change continues to outstrip standardisation. New risks emerge faster than formal test protocols can be developed and adopted. In practice, this means that tailored fire testing remains essential. The water mist industry has demonstrated a strong capacity to respond rapidly to these emerging risks through targeted research programmes, often supported by public funding and international collaboration.

* Interior of battery test compartment – SafeBESS project

Two recent research initiatives are presented as examples illustrating this capability and the suitability of water mist for modern fire safety challenges.

BATTERY ENERGY STORAGE SYSTEMS

As lithium-ion batteries are increasingly installed indoors for energy storage, questions around fire safety are becoming more prominent. Thermal runaway events can escalate quickly, producing significant heat and venting toxic and flammable gases inside a battery room, which not only contribute to potentially rapid fire growth but also introduce an explosion risk if the vented gases are allowed to accumulate. To study these scenarios and their interactions with different suppression technologies, RISE Fire Research in Norway has conducted a series of unit scale fire experiments. These experiments, carried out as part of the SafeBESS project, included evaluations of both high and low pressure water mist in a purpose built battery room.

The experiments were conducted inside a 3 × 6 × 3 metre battery room. The room was equipped with balanced

* Full scale fire tests in Spain - SUVEREN4Depot

mechanical ventilation, deflagration panels, gas and smoke detection, and many temperature, pressure and gas measurement points. A multi module lithium-ion battery cabinet equipped with NMC pouch cell modules representative of indoor battery energy storage systems was installed. The room was further equipped with several fixed suppression systems, including high pressure water mist, low pressure water mist, a sprinkler system and an IG 541 inert gas system. Thermal runaway was intentionally triggered by applying controlled electrical heating to four neighbouring pouch cells within one module.

A central focus of the test programme was the performance of the water mist suppression systems. In the experiments, their performance was assessed by observing how each system influenced the fire conditions following thermal runaway, including changes in heat development, the behaviour and ignition of vented gases and whether visible flames persisted after activation. Instrumentation such as thermocouple arrays, pressure measurements in the room, gas measurements in the extraction duct, and visual documentation from cameras and infrared imaging made it possible to follow how the conditions evolved throughout the event, allowing the different suppression systems to be compared under otherwise identical full scale conditions. After each experiment, the wall construction behind the battery was opened, enabling assessment of any material damage to the construction.

The detailed results from these experiments will be published in a separate scientific paper. However, water mist technology showed efficiency. The large scale work at RISE Fire Research already demonstrates the value of realistic full room testing when evaluating suppression concepts for indoor BESS installations. As a final deliverable, the SafeBESS project will also develop guidelines and recommendations for best practice with regard to the safe implementation of BESS in buildings.

BUS DEPOTS AND ELECTRIFIED TRANSPORT

The electrification of public transport is progressing rapidly, bringing significant benefits but also new fire safety considerations. Bus depots represent a particularly challenging environment. Large numbers of vehicles are parked in close proximity, often within enclosed or semi-enclosed structures. Real incidents have demonstrated how rapidly a single vehicle fire can escalate, leading to major disruptions to public transport operations as well as substantial financial losses.

Electrification introduces additional risk factors, particularly related to lithium-ion battery systems, charging infrastructure and continuously energised onboard systems. These can act as potential ignition sources and may contribute to fire development in traction batteries, auxiliary electrical systems or associated infrastructure.

Within the SUVEREN research framework, a dedicated test programme was developed to address these challenges. A central outcome of this work is a new full-scale fire test protocol specifically designed for evaluating fixed firefighting systems in bus depot environments.

The protocol defines a comprehensive methodology for testing under realistic and severe conditions. It considers both conventional buses and battery electric vehicles, recognising that while ignition sources may differ, the overall fire load and development can be comparable. A key feature of the methodology is the use of a standardised bus mock-up. This approach ensures repeatability and comparability between tests, avoiding the variability associated with real vehicles.

The mock-up represents a typical twelve metre bus and incorporates both passenger and technical compartments. The defined fire load combines a significant amount of standardised Class A materials with minimum 300kWh real lithium-ion battery system in order to reproduce a realistic fire development and heat release rate representative of real bus fires. The project was developed in close collaboration with public transport stakeholders to ensure practical relevance and applicability.

The fire tests, which were carried out in Germany, showed that water mist systems are particularly well suited to the challenges of bus depots and modern buses, whether electric or conventional combustion engine. The ability of water mist to provide efficient cooling and block heat radiation makes it highly effective in limiting fire spread. In addition, their relatively low water demand can be advantageous in facilities where water supply or drainage capacity is limited. Previous large-scale fire tests, including heavy goods vehicle scenarios such as those in road tunnels, have already demonstrated the strong performance of water mist under demanding conditions.

The development of the SUVEREN4Depot fire test protocol also demonstrates the agility of the water mist industry. Faced with a rapidly emerging risk, a comprehensive and technically robust testing methodology has been developed within a relatively short timeframe. This provides immediate value to operators, designers and authorities, even before formal standardisation processes are completed.

"Water mist technology has developed into one of the most versatile and efficient fire protection solutions available"

ADAPTING TO A CHANGING RISK LANDSCAPE

The two example case studies presented here highlight a common theme. Fire safety challenges are evolving rapidly, driven by electrification, new materials and changing operational environments. Traditional approaches are not always sufficient to address these risks.

Water mist technology offers a flexible and adaptable solution. Its performance-based nature allows systems to be tailored to specific applications and validated through targeted fire testing. This enables a faster response to new risks compared to purely prescriptive approaches and avoids the long timelines typically required to develop new standards.


* Exterior of battery test compartment – SafeBESS project

At the same time, the industry continues to contribute to the development of standards and guidelines. The knowledge gained from research programmes and broader industry activities is essential for informing future regulatory frameworks and ensuring that they remain relevant. This is also a key priority for the International Water Mist Association.

Perhaps most importantly, these developments demonstrate the capacity of the water mist industry to innovate. Through collaboration between manufacturers, research institutes and end users, new challenges can be addressed in a structured and scientifically robust manner.

Water mist has established itself as a key technology in modern fire protection, combining efficiency, versatility and a strong foundation in performance-based fire testing.

As electrification continues to transform infrastructure and transport, the need for adaptable and high-performance fire protection solutions will only increase. The examples presented demonstrate that the water mist industry is capable of responding to these challenges and is actively contributing to the development of new knowledge and methodologies.

In a rapidly changing risk environment, this ability to respond quickly and effectively is essential. Water mist is therefore not only a solution for today's challenges, but a technology well positioned for the future. FB