

# Water Mist - TAILOR MADE *for* evolving risks

IFSJ hears exclusively from Janne Siren Fjærestad, Christoph Meraner, Kristian Hox (RISE – Norway) and Max Lakkonen (IFAB) on behalf of IWMA about water mist technology

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.

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.

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 – SafeBESS, Norway

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 water mist industry has repeatedly demonstrated its ability to develop robust testing methodologies within relatively short timeframes.”**

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

The detailed results from these experiments will be published in a separate scientific paper. However, water mist technology showed very good 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.

## Lithium-ion batteries in rack storage - SUVEREN2Use

Lithium-ion batteries (LIBs) may be stored several times during their life cycle: after cell or module production, during transport and warehousing, before installation and again after removal, second-life use or recycling. Rack storage is a particularly demanding fire safety challenge because large quantities of LIBs may be placed close together, often in dense pallet loads where water conventional ceiling-level system have no or limited access to the actual seat of the fire.

Within the SUVEREN2Use research project, including consortium partners such as the University of Wuppertal, Fraunhofer and FOGTEC as the fire suppression provider, a full-scale test programme was developed to study fire protection concepts for LIBs stored in rack arrangements. The concept and tests were witnessed by TÜV. Much previous testing has focused on scenarios where ignition and propagation are dominated by packaging materials. The SUVEREN2Use work deliberately challenged this assumption by ensuring that the batteries themselves became involved in the

fire. The objective was to evaluate whether a protection concept could interrupt uncontrolled fire spread through the rack and limit the fire within ignition bay.

A key feature of the test campaign was the use of real LIB modules as the primary fire load. The tests included demanding NCA and NMC chemistries, cylindrical and prismatic cell formats (cylindrical cells can cause flying projectiles providing extra challenge over larger distances), and batteries at full state of charge (100% SOC). The approval tests used up to 200 kWh and around 800–1,000 kg per pallet, with the modules packed in cardboard and wrapped in plastic film to represent realistic storage conditions. The protection concept combined a rack-integrated high-pressure water mist system with non-combustible vertical and horizontal fire barriers. Automatic nozzles applied water mist directly inside the rack structure, close to the fire source, while the barriers were intended to limit lateral, vertical and rearward fire spread.

## “New challenges can be addressed in a structured and scientifically robust manner.”

The fire was initiated by overheating inside the pallet, with the ignition source located deep in the lower part of the load. This created a severe and realistic challenge because battery involvement started



before the packaging material became the involved to fire. Thermocouples on the ignition and target pallets, rack temperature measurements, system pressure data, visual documentation and post-test damage mapping were used to assess performance.

The results showed strong performance. The fire developed intensively in the ignition bay, but flame extension was controlled, the exposed rack area was cooled and the target pallets were protected from involvement. The results indicate that rack-level water mist, combined with structural barriers, can provide an evidence-based approach for controlling propagation in lithium-ion battery rack storage, even in very demanding warehouse environments. More information available [suveren2use.de](http://suveren2use.de)

### 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.

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.

### Conclusion

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.

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.

