



NEW ERA IN FIRE PROTECTION:

The Rise of Autonomous Robotic
Fire Suppression (ARFS) Systems

The fire protection industry is on the verge of a revolution. Autonomous Robotic Fire Suppression (ARFS) systems are poised to reshape safety standards for large-scale indoor and outdoor environments. Also known as autonomous fire monitors or automatic fire monitors, ARFS systems combine advanced fire monitors (a.k.a. water cannons) with cutting-edge fire detection technologies, including flame detectors, thermal imaging cameras and video analytics.

While still in early adoption stages, ARFS technology is rapidly advancing and quickly gaining traction due to its groundbreaking advantages. ARFS systems can detect fires almost immediately, locate them with precision, and accurately and intelligently target them with a high-volume water or foam stream directly at and around the fire's source. Because of its far superior capabilities of suppression fires immediately, this technology is expected to soon disrupt traditional fire protection methods in large, high-risk industrial and commercial facilities.

ARFS systems currently function as a supplemental layer to traditional fire protection methods, largely due to the absence of established testing and approval standards that would allow them to fully replace conventional systems. However, as ARFS technology continues to demonstrate proven reliability and effectiveness, it's expected that fire codes and standards will adapt, paving the way for these systems to become primary methods of fire suppression. Though not yet mandated, the voluntary adoption of ARFS systems is accelerating rapidly, driven by their clear and numerous benefits.

WHY TRADITIONAL SYSTEMS CAN'T COMPETE WITH ARFS CAPABILITIES

Fires can grow exponentially, doubling in size every 10 to 60 seconds, depending on fuel type, ventilation, and the overall fire load in the environment. This rapid, exponential growth makes it critically important to contain and suppress a fire as soon as it begins. Effective fire suppression in these early stages demands a rapid, high-volume response, directly aimed at and around the fire's source. Any delay, or the application of a low water density, significantly increases the likelihood of uncontrollable spread, severe damage, and risk to lives. Every second truly counts.

In large, high-risk environments, traditional fire protection methods - such as sprinklers, deluge systems, and fire brigades - are limited by slower response times and/or the inability to deliver high volumes of water precisely at the fire's source. These

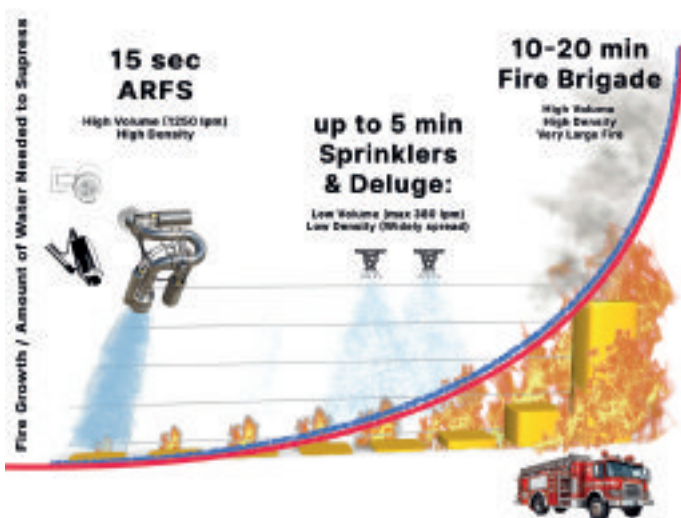


How ARFS Systems work

1. Detect a fire within seconds
2. Compute location and size
3. Suppress the fire within seconds
4. Shut off the flow
5. ... return to standby

inherent constraints make them considerably less effective than ARFS systems in fast-developing fire scenarios, where immediate, high-volume, and precisely targeted suppression is essential.

- **Sprinklers:** Sprinklers are activated only after flames produce high temperatures, which can result in several minutes of delay before they respond. Even the quickest systems, such as Early Suppression Fast Response (ESFR) sprinklers, may take from 30 seconds up to a few minutes to deploy. Once activated, sprinklers distribute water at a relatively low flow rate (up to about 380 litres per minute) and cover a wide area. This results in low water density at the fire's source, more akin to a heavy rainfall than targeted suppression. While sprinklers are effective at cooling and slowing fire spread, their primary function is to safeguard the building's structural integrity until fire services arrive. They are not intended to protect the contents within the building. Additionally, many sprinklers lack automatic shutoff mechanisms, leading to excessive water usage and avoidable water damage to the building's interior and assets. This can also cause significant environmental harm through toxic runoff.
- **Deluge Systems:** Designed to flood an area with water from multiple open nozzles, deluge systems activate entire sections simultaneously, creating broad coverage. However, this widespread application can lead to considerable collateral damage, affecting valuable assets within the facility that may not be directly threatened by the fire. Additionally, deluge systems deliver a low-density water flow over the fire area rather than a concentrated stream, which can be less effective at quickly suppressing a localised blaze. While they are typically activated by fire detection systems, deluge systems are prone to false alarms and unnecessary activations, causing both water waste and potential damage. These systems are often most suitable for limited, high-risk zones rather than broad areas, as their lack of precision can lead to unintended and costly consequences throughout a facility.



- **Fire Brigades:** Fire brigades provide invaluable service and can deploy high-density water or foam. Problematically, however, they typically require 5 to 15 minutes - or more - to arrive and set up

equipment after receiving a fire alert, which itself can take minutes. By the time they are ready to act, fires have often grown exponentially for many minutes, escalating into massive blazes that pose severe risks to property, the environment, and lives. Controlling such a large, established fire also demands exponentially more water. While often highly effective upon arrival, the reliance on human intervention and response time limits firefighting efficiency in fast-escalating incidents, where immediate suppression is essential.

ADVANTAGES OF ARFS SYSTEMS

In large environments, Autonomous Robotic Fire Suppression systems offer a number of critical advantages over traditional fire protection methods, making them a far superior choice for high-risk facilities.

- **Immediate Response:** ARFS systems can detect and start suppressing fires within as little as 15

seconds, a crucial factor given the exponential growth of fire. By intervening at the very earliest stage, the fire is typically still very small and easily managed, providing the very best possible chance of minimising damage and risk.

- **Precision Targeting and High-Density Suppression:** Unlike traditional sprinklers, which disperse water over a wide area, ARFS systems excel in delivering a concentrated and high-density stream of water or foam directly at the fire's source. These advanced systems can accurately locate the fire and intelligently aim a powerful stream - typically 1250 litres per minute or more - precisely around and over the flames. This targeted approach not only prioritises immediate containment but also significantly reduces the risk of fire spread and greatly increases the chances of rapid extinguishment. By rapidly focusing a high volume stream exactly where it's needed, ARFS systems minimise the total amount of water required to extinguish a fire, leading to less collateral damage and lower environmental impact. This rapid, precise application ensures that every drop counts, effectively suppressing the fire while conserving resources.
- **Advanced Detection Capabilities:** ARFS systems can be equipped with a wide range of fire detection technologies, including flame detectors, thermal imaging cameras, video analytics, and others. Moreover, they can combine and condition multiple detection technologies and achieve extremely fast reaction times - often in under 15 seconds - as well as extremely low risk of false alarms.
- **Automatic Shut-Off:** ARFS systems can detect when

a fire has been extinguished and automatically shut off, reducing unnecessary water use, property damage, and toxic runoff. This is a notable advantage over traditional methods, which may continue to discharge water over large areas and for long periods of time, even long after the fire is out.

- **Remote Control Capability:** Although ARFS systems operate completely autonomously, they also allow human operators to take manual control of the fire monitor at any time, even if the system hasn't automatically activated. This remote control capability - via joystick, mobile app, or secure computer connection - adds an extra layer of protection. It allows an operator to proactively address potential fire hazards that may not yet be detected by the automatic system, such as abnormal heat buildup or visible smoke, ensuring comprehensive fire safety coverage in complex, high-risk environments.
- **Reduced Facility Downtime:** By containing and extinguishing fires quickly and efficiently, ARFS systems minimise operational disruptions and recovery times, often allowing facilities to resume operations immediately. This rapid response is crucial for industries where every minute of downtime can lead to significant financial losses.

APPLICATIONS IN HIGH-RISK INDUSTRIES

Due to their significant advantages and benefits, ARFS systems are increasingly being adopted across





a range of high-risk sectors, each benefitting from the technology's unique capabilities. Below are just some of the many applications for which ARFS systems are very well suited.

- **Waste and Recycling Facilities:** These facilities handle combustible materials, and fires frequently occur due to various causes, including the presence of lithium-ion batteries. Rapid detection and response are critical.
- **Military and Civilian Warehouses:** Autonomous systems quickly detect and contain fires in warehouses storing valuable or combustible items such as military assets, fuels, electronics, and chemicals. ARFS systems are especially and uniquely well suited for facilities storing highly explosive materials where fire brigades may be unable to intervene.
- **Manufacturing and Heavy Industry:** Facilities filled with combustible materials, machinery, and stored goods can reduce the risk of large-scale incidents with fast, targeted suppression.
- **Aircraft Hangars:** ARFS systems provide rapid, precise suppression without the collateral damage often associated with foam deluge systems, which can damage both aircraft and hangar infrastructure. While current fire code regulations have yet to catch up and implement autonomous systems, they can offer substantial advantages and cost savings in hangars.
- **High-Rise Buildings with ACM Façades:** In buildings with flammable Aluminum Composite Material (ACM) cladding, ARFS systems can rapidly detect and suppress façade fires all the way to the top of the tallest of high-rise buildings, providing a cost-effective alternative to façade replacement. ARFS systems can


also be used to protect other building exteriors.

- **Cement Plants:** With Refuse-Derived Fuel (RDF) and other combustible materials stored in large quantities to be used in the production process, cement plants face high fire risks, for which ARFS systems are an ideal solution.
- **Ro-Ro Ship Weather Decks and Car Decks:** ARFS systems can protect vehicles tightly packed on weather decks, containing fires before they spread to passengers and crew. Specialised ARFS concept systems for low-clearance car decks are also under development and expected to soon be tested.
- **Historical Buildings:** Many historic structures are vulnerable to fire damage due to highly flammable materials. ARFS systems can protect these irreplaceable assets, increasing the likelihood of preservation.
- **Tunnels and Confined Spaces:** Autonomous fire suppression systems offer unique benefits in tunnels and similar environments, where quick detection and containment can prevent catastrophic outcomes.

THE FUTURE OF FIRE PROTECTION IS INEXORABLY GOING AUTONOMOUS

Fire protection is on the brink of a paradigm shift as automation becomes the new standard. ARFS systems are already proving their superior effectiveness, providing a significantly faster, more precise response, and the technology is rapidly evolving. While current regulations do not yet mandate ARFS systems, the undeniable benefits they offer are driving demand across industries seeking better ways to protect their assets and personnel, and regulatory changes are sure to soon catch up.

Manufacturers of ARFS systems are witnessing a surge in demand across high-risk sectors, as industries recognise the advantages of rapid fire suppression, precise high-volume water or foam application, reduced overall water usage, minimised damage and downtime, and a significantly lower environmental impact.

The trajectory is clear: autonomous fire protection is not only here, but is set to expand rapidly. This shift marks a pivotal advancement in fire safety, redefining the ways we protect lives, property, and the environment. ARFS systems represent the dawn of a new era in fire protection, one that prioritises precision, speed, and effectiveness in addressing the unique challenges of modern high-risk facilities. 



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