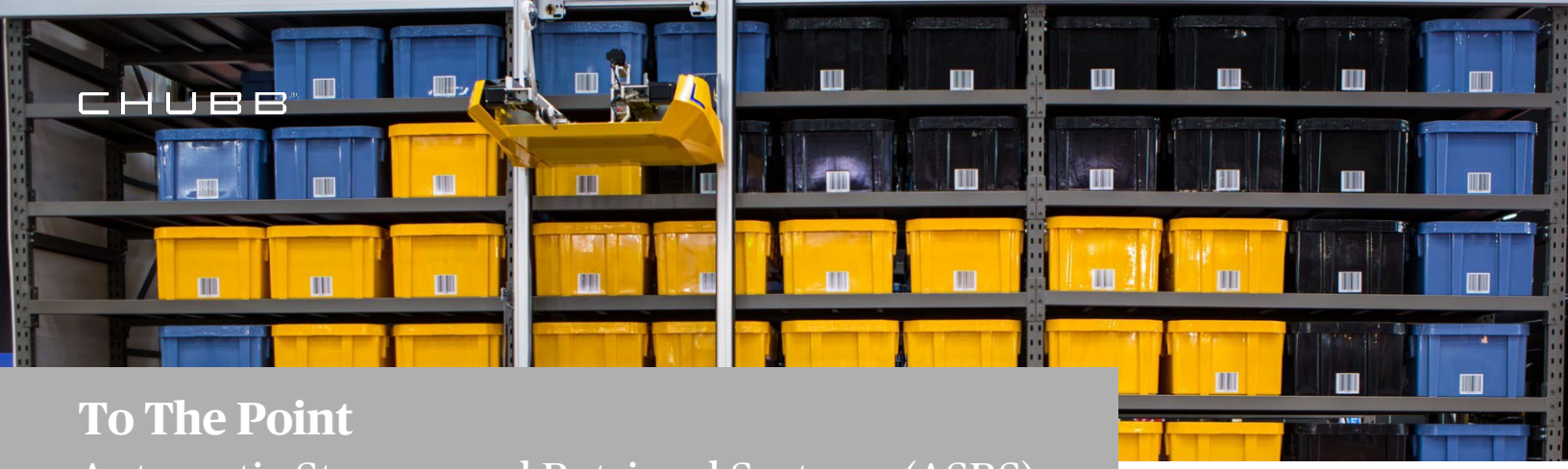

To The Point
Automatic Storage and Retrieval Systems (ASRS)

Automatic Storage and Retrieval Systems (ASRS) have become integral to modern manufacturing and warehousing operations. These systems, as the name suggests, automate the storage and retrieval of goods, offering significant improvements in speed and efficiency. By replacing traditional shelving and racking with high-density storage arrays, ASRS maximize the use of available storage volume within a facility. From a warehousing perspective, ASRS provide numerous advantages, including a reduced physical footprint, decreased labor requirements, and enhanced workforce safety through improved ergonomics.

Types of ASRS and Associated Fire Risks

The primary types of ASRS include Mini-Load, Rack Structure, Top Loading, and Vertically Enclosed systems. While these systems offer operational efficiencies, they also introduce unique fire hazards to warehouse environments. Key components such as material handling robots, shuttles, batteries, cranes, and charging stations are potential ignition sources. These components are susceptible to fire risks stemming from overheating, electrical malfunctions, mechanical collisions, and equipment breakdowns.

A significant concern is the use of lithium-ion batteries in ASRS robots and shuttles. These batteries can overheat and, under certain conditions, experience **thermal runaway**, a phenomenon that can lead to fires and the release of explosive gases. To mitigate this risk, it is recommended to use lithium-ion batteries that have passed a thermal runaway propagation test in accordance with **IEC 62619** or an equivalent industrial standard.

Design Challenges and Fire Protection Implications

The design of ASRS warehouses inherently increases fire risks. Unlike traditional warehouses, automated facilities often eliminate or significantly reduce aisles and flue spaces (the open spaces between pallets or containers) since worker access is not required. Additionally, products are frequently stored in open-top or combustible plastic containers to streamline order fulfillment processes. These design choices can hinder the effectiveness of standard fire suppression systems, such as **ESFR (Early Suppression Fast Response)** sprinklers, as water may collect in or on the containers, preventing it from reaching lower storage levels.

Given the high-density storage configurations and the absence of traditional flue spaces, a combination of ceiling-level sprinklers and in-rack sprinklers is typically required to achieve adequate fire protection. ASRS fires demand large volumes of water for suppression, necessitating a robust water supply system, often supplemented by an automatic fire pump to maintain the required pressure.

Applicable Standards and Guidelines

While building codes frequently reference **NFPA 13** for the installation of automatic sprinklers, the 2025 and earlier editions of NFPA 13 do not specifically address ASRS. As such, fire protection strategies for ASRS should be guided by **FM Global Data Sheet 8-34**, which provides detailed recommendations for these systems.

Firefighting Challenges

Although sprinkler systems play a critical role in controlling and suppressing fires, manual intervention by the fire department is essential to ensure complete extinguishment. However, firefighters often lack experience with ASRS environments, which present unique challenges such as high storage densities, reduced or non-existent aisles, and tall storage units. These factors can significantly delay efforts to apply manual hose streams to the fire's origin. In many cases, the ASRS and its components must be disassembled from the perimeter to access the fire, prolonging suppression efforts and increasing the risk of water and smoke damage to the system, stored goods, and surrounding areas.

This is particularly concerning when the stored products are sensitive to smoke and water damage. Therefore, it is critical to incorporate comprehensive fire protection, detection, and firefighting pre-planning into the overall risk management strategy for ASRS facilities.

Key Pre-Planning Considerations

Effective pre-planning should involve collaboration with the local fire department to ensure they are familiar with the ASRS layout, equipment, and potential hazards. This may include specialized training and equipment provided by the ASRS manufacturer. At a minimum, the pre-plan should address the following:

- **Access to the Fire:** Strategies for reaching the fire within the storage array.
- **Disassembly Procedures:** Methods for dismantling the storage array to access the fire's origin.
- **Specialized Equipment:** Guidance on the use of fixed monitors, hose station connections, remote-controlled nozzles, and visible/infrared cameras.

Fire Detection and Mitigation Measures

The type and arrangement of storage containers significantly influence fire risks. Non-combustible, closed-top containers generally present lower risks compared to open-top or combustible plastic containers. Fire protection specialists should evaluate these factors to develop tailored protection strategies.

Early detection systems are a critical component of ASRS fire protection. **Very Early Warning Fire Detection Systems (VEWFDS)** are commonly specified for ASRS, as they can detect combustion products before they are visible to traditional heat or smoke detectors. These systems enable the rapid shutdown of electrical systems, including robots and shuttles, and provide early notification to emergency responders and building occupants.

ASRS robots and shuttles should also incorporate interlocked safety measures to prevent the spread of fire. These measures may include automatic shutdowns upon fire detection and emergency braking systems. Regular inspection and maintenance of robots, shuttles, and charging stations are essential to ensure their safe operation.

Limitations and Common Issues

While ASRS offer significant operational benefits, they also present unintended consequences. Even a successfully controlled fire can result in the loss of stored goods, damage to robots and shuttles, and potentially the entire system. Common limitations and issues include:

- Inadequate pre-incident fire plans and coordination with local fire departments.
- Incomplete or non-compliant fire sprinkler plan submittals.
- Attempts to comply with fire protection standards (e.g., NFPA 13) that do not yet fully address ASRS.
- Insufficient details on commodity types, container materials, and storage configurations.
- Lack of fire detection plans and interlocking details between fire alarms and robot deactivation.
- Absence of adequate flue space (transverse and longitudinal) and comprehensive racking plans.

Resources

ESFR Sprinkler Obstructions

Fire Detection

Lithium-ion Batteries Storage Considerations

Learn More & Connect

For more information on protecting your business, contact your local risk engineer, visit the Chubb Risk Consulting Library, or check out www.chubb.com/riskconsulting.