Tactical Measures for Manual Firefighting for the AutoStore system

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The cube storage system AutoStore was created in the late 90’s based on the idea of technical director Ingvar Hognaland, he recognized that there was too much air in traditional storage systems. An AutoStore system consists of five modules, robots, grid, ports, controller, and bins. The dense storage system stores good in open-top containers stacked directly on top of each other. Warehouses complexity is increasing, as more and more automation is added into the warehouses, which again causes challenges for firefighters and their tactical measures.

AutoStore has taken a scientific approach to fire safety, since 2009 AutoStore has conducting over a 100 small-, intermediate- and large-scale fire test, with different fire protection designs, such as foam, hypoxic air, and ceiling-level sprinklers. The fire tests have been conducted at the research laboratories RISE Research Institute of Sweden (RISE) and Underwriters Laboratories Inc. (UL) in the US. Based on the results, valid fire protection measures for a AutoStore system have been developed. Our fire tests show that a ceiling-level sprinkler system suppresses and controls a fire within the AutoStore system.

Final extinguishment in any facility is usually accomplished by manual firefighting efforts, as the main purpose of a sprinkler system is to suppress and control a fire. In May 2021, AutoStore in collaboration with Underwriters Laboratories and their Subject Matter Experts developed tactical measures for accessing the seat of the fire from floor level. The test was conducted on a full height grid, 21 ft. 3 inches tall. 19 firefighters from across the US was invited to participate in the fire test, to validate the tactical measures. The fire was ignited at floor level, and K14 ceiling level sprinklers was installed at a ceiling height of 25 ft. During the test one sprinkler operated, suppressing, and controlling the fire, the sprinkler was allowed to operate for 1 h before the test set-up was handed over to the firefighters. In total the firefighters removed the outer panels (MDF) and 7 and 2/3 rows, 3 bins wide to get to the seat of the fire and confirm final extinguishment. It was concluded that the method was safe, with no grid collapse or falling bins. It also brough awareness for the firefighters how to fight a fire within the dense AutoStore system in a systematic order to prevent falling objects and avoid content spill.

Previous tests have shown that sprinklers will suppress and control the fire. The first steps towards a concept for final extinguishment with only ceiling-level sprinklers were taken at UL in May 2021. A full height grid was used for the sprinkler tests, and ignition was at floor level, replicating a worst-case scenario with a fire in the lower part of the system. In the test with a ceiling height of 13.7 m (45 ft.), final extinguishment was accomplished with one activated K360 (K25.2) ceiling-level sprinkler following a declining density curve.
AutoStore has continued to research a sprinkler design for final extinguishment with ceiling-level sprinklers only, continuing the work conducted at UL in 2021 but following a standard sprinkler test curve. The goal was to achieve final extinguishment with ceiling level sprinklers only, meaning no additional manual firefighting efforts needed. The overall goal of the test series was final extinguishment by ceiling-level sprinklers for three different scenarios with ignition to sprinkler locations: ignition under 1, between 2 and between 4 sprinkler(s). The ignition source was located at floor level, and the adjacent three bin rows where partially filled with bins. In addition to the partially filled stacks, on top of these stacks three mock-up robots were placed. Allowing for a broader fire spread and several obstacles impacting water displacement, deemed to be a worst-case scenario. Final extinguishment was achieved for the three scenarios for a ceiling height of 9.1 m (30 ft.), with limited lateral fire spread and a maximum of 3 sprinklers operating.