

- The fire alarm systems in the towers provided for automatic fire detection, but required manual activation of notification devices. On September 11, 2001, the impact of the aircraft itself alerted occupants in the WTC buildings to the unfolding danger when the first aircraft hit.
- Soon after the first aircraft impact, an overwhelming number of alarms were displayed at the Fire Command Station in WTC 1. The alarm systems were only capable of determining and displaying (a) areas that had at some time reached alarm point conditions and (b) areas that had not. The quality and reliability of information available to emergency responders at the Fire Command Station was not sufficient to understand the fire conditions.
- Although the fire alarm systems used multiple communication path risers, the systems experienced performance degradation, especially in WTC 1 where all fire alarm notification and communication functions appear to have been lost above the floors of impact.
- There was no means at the Fire Command Stations to determine whether or not announcements reached and could be heard on the intended floors.
- Alarm systems store information that is valuable for understanding the fire and smoke development in a building, but no information from the fire alarm systems was located, and there was no indication that anyone looked for it during the cleanup of the WTC site. Survivability of alarm systems data on computer hard drives, memory modules, or printouts in building fires and collapse environments is not addressed in present installation standards.
- Transmission of critical data outside the building to a monitoring station would provide means to preserve event data.
- Except for specific areas that were exempted from required sprinkler coverage, sprinkler systems were installed throughout the towers. As designed, the water supplies (storage tanks and pumped city water), automatic sprinklers, and standpipe/pre-connected hose systems met or exceeded the applicable installation requirements in the NYC Building Code. There were other design features that were considered inconsistent with engineering best practices, but no evidence was found to indicate that these features affected the events that occurred on September 11.
- All the fires that occurred in sprinklered spaces in the towers prior to September 11, 2001, were controlled with three or fewer sprinklers, in some cases supplemented by manual fire fighting.
- On the floors where the major fires occurred on September 11, 2001, the sprinkler system played no part since their water supply was damaged by the aircraft impact. The typical sprinkler system was installed with one connection to the sprinkler riser, providing a single point of failure of the water supply to the floor level sprinklers.
- The sprinkler systems could have provided fire control at coverage areas up to two or three times the specified design area of 1,500 ft<sup>2</sup>. However, 4,500 ft<sup>2</sup> constituted less than 15 percent of the area of a single floor in these buildings, and estimates of the extent of the