



# RESEARCH FOUNDATION

RESEARCH FOR THE NFPA MISSION

## PROJECT SUMMARY

### ESFR Sprinklers and Obstructions – Phase 4

31 August 2019

**Background:** ESFR sprinklers are often installed in warehouses to avoid installation of in-rack sprinklers. However, since the discharge pattern of ESFR sprinklers is different from standard-spray sprinklers, obstructions near the sprinkler heads can greatly affect the distribution of water. NFPA 13, Standard for the Installation of Sprinkler Systems, generally allows the following obstructions in Sections 14.2.11.1, 14.2.11.2, and 14.2.11.3:

- Sprinklers installed per the allowable distances from near or at ceiling obstructions in Table 14.2.11.1.1
- Isolated obstructions less than 2 feet wide and 1 foot or greater horizontally from sprinkler
- Isolated and continuous obstructions less than 2 inches wide and 2 feet or greater below deflector or 1 foot or greater horizontally from sprinkler
- Continuous obstructions 1 foot or less in width and located 1 foot horizontally from sprinkler
- Continuous obstructions 2 feet or less in width and located 2 feet horizontally from sprinkler
- Bottom chords of bar joists or open trusses located 1 foot or greater horizontally from sprinkler (upright sprinklers can be installed over the bottom chords of bar joists or open trusses that are up to 4 inches wide)

Two methods are available in NFPA 13 to resolve obstructions that do not fall into the categories above: eliminating the obstruction or adding sprinklers underneath the obstruction. However, there have been some successful tests that have been conducted with obstructions that are not allowable by NFPA 13 without taking these measures.

Phases 1-3 of this project focused on developing an understanding of the effect various obstruction scenarios have on ESFR sprinkler performance. Eight full-scale and approximately 40 Actual Delivered Density (ADD) tests have been completed to date. From the full-scale fire tests that were conducted, the following conclusions can be made:

- K17 ESFR sprinklers obstructed by a 1.5-inch x 1.5-inch bridging member located 12 inches directly below the sprinkler produced acceptable results. In conjunction with the results of Phase 2, it can be said that bar joists 26-36-inches deep, 6 inches horizontally offset from the sprinkler with a 1.5-inch x 1.5-inch bridging member located directly under the sprinkler will not significantly decrease the performance of the ESFR sprinkler.
- K17 ESFR sprinklers obstructed by a 6-inch wide flat obstruction located 6 inches horizontally offset and 20 inches below the sprinkler produced acceptable results.

All full scale testing by the Foundation to date has been conducted with K17 ESFR sprinklers. However, there is a need to expand to consider building stock with K14 ESFR sprinklers installed and evaluate the effect of these obstructions on sprinkler performance for these existing installations. In addition, a

comprehensive summary of the testing completed to date is needed to provide guidance to the NFPA 13 Technical Committees.

**Research Goal:** The overall goal of the research program is to develop a tool that can be used for providing reliable analysis of the impact of obstructions on ESFR sprinklers based on existing data and develop technical basis to the NFPA 13 Technical Committees for new requirements and guidance. The goal of this phase of the program is to evaluate the impact of obstructions on K14 ESFR sprinklers to build on the testing already completed with K17 sprinklers, which will be used as inputs into the tool.

**Project Tasks:**

**Task 1:** Conduct a literature review of past ESFR sprinkler obstruction work and droplet phenomena research and prepare a test plan, which presents the proposed testing parameters for a series of Actual Delivered Density (ADD) tests and up to two full scale tests, to evaluate the impact of obstructions on K14 ESFR sprinklers. Review the test plan with the Technical Panel and address feedback.

**Task 2: Testing**

- **Task 2a:** Coordinate with the test lab on the test details and attend the ADD testing. After the ADD testing, review the results with the Technical Panel to finalize the parameters for the full scale test(s).
- **Task 2b:** Coordinate with the test lab on the test details and attend the full scale tests. Prepare a summary report of all testing and review with the Technical Panel.

**Task 3:** Prepare a comprehensive summary report of all the ESFR sprinkler obstruction work completed to date (including the testing with K14 ESFR sprinklers) with recommendations for any new guidance or requirements related to the obstruction rules for ESFR sprinklers. In addition, highlight any potential future research needs. Review the report with the Technical Panel.

**Task 4:** Respond to Panel comments on the draft report and develop a final report.

**Implementation:** This research program will be conducted under the auspices of the Research Foundation in accordance with Foundation Policies and will be guided by a Project Technical Panel who will provide input to the project, recommend contractor selection, review periodic reports of progress and research results, and review the final project report.

**Schedule:**

Task 1: March 2019  
Task 2: ADD Testing – April 2019  
Task 3: Full scale Testing – September 2019  
Test Summary – October 2019  
Draft report: November 2019  
Final report: December 2019

**About us:**

**About the Fire Protection Research Foundation**

The [Fire Protection Research Foundation](#) plans, manages, and communicates research on a broad range of fire safety issues in collaboration with scientists and laboratories around the world. The Foundation is an affiliate of NFPA.



### **About the National Fire Protection Association (NFPA)**

Founded in 1896, NFPA is a global, nonprofit organization devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards. The association delivers information and knowledge through more than 300 consensus codes and standards, research, training, education, outreach and advocacy; and by partnering with others who share an interest in furthering the NFPA mission. [All NFPA codes and standards can be viewed online for free.](#) NFPA's [membership](#) totals more than 65,000 individuals around the world.

