# A Report on the Navy Aircraft Hangar Research Project

The Naval Facilities Engineering Command (NAVFAC) and the National Institute of Standards and Technology (NIST) are conducting full scale fire experiments in two Navy aircraft hangars. The purpose of this project is to provide scientific data on actual jet fuel fires in high bay hangars. The Navy, and subsequently all of the Department of Defense will Utilize this data to reevaluate and revise their criteria for the protection of aircraft hangars.

## Background

Aircraft hangars, like other high bay occupancies, pose a challenge to fire protection engineers. The problems associated with high bay occupancies include the lack of high bay test data, the unknown effects of wind and stratification, unreliable activation prediction models, and the difficulty in detecting and suppressing a fire where the fuel can be greater than 100 feet below fixed fire protection systems. In addition, codes and standards offer no real guidance for ceiling heights above 30 feet.

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The Navy's primary reasons for conducting these experiments are to reevaluate its design criteria for aircraft hangars based on actual data using jet fuels. False activation of overhead deluge systems have resulted in users wanting to disconnect those systems when aircraft are present in the hangar. Considerations include the fact that the military has changed fuel types from JP-4 to JP-5 and JP-8. The military has also changed its criteria to reflect the use of closed head sprinkler systems at the ceiling. Although that criteria presently requires those sprinkler systems to include aqueous film-forming foam (AFFF), that requirement may be revised if these experiments show that the overhead sprinklers really only cool the ceiling. Furthermore, because of environmental concerns, the Navy is considering limiting the use of AFFF systems in hangars to the underwing suppression systems.

## Project Description

The project consists of five phases. In Phase 1, NIST conducted laboratory scale tests to determine the burning rates of JP-4, JP-5 and JP-8 as a function of pan diameter. These were completed in FY 94. Under Phase 2, NIST ran three-dimensional computer models to help design the instrumentation plans for the selected hangar test sites. Phase 3 consisted of full scale experiments in a warm climate. These were conducted at the Naval Air Station, Barbers Point, Hawaii, February 13-24, 1995. Phase 4 includes full scale experiments in a cold climate at the Naval Air Station, Keflavik, Iceland, May 1-13, 1995. Phase 5 includes data analysis and report preparation.

The selected hangars for these experiments were 50 and 70 feet in height. The choice of hangars in cold and warm climates was to determine the effects of ambient temperature on stratification. Additionally, both sites have normally high wind conditions which met another selection criteria for the open door tests. The fuels burned included JP-5, JP-8 and wood cribs. Each hangar was instrumented with over 200 data measuring points which included not only typical scientific instruments such as thermocouples, radiometers, velocity meters and anemometers, but also conventional fire protection devices. These included photoelectric smoke detectors, heat detectors, combination UV/IR optical detectors, projected beam detectors, line-type heat detectors, and a variety of sprinkler heads. The sprinkler heads ranged from 175°F and 286°F sprinklers depending on ceiling heights of 50 and 70 feet, the effects of draft curtains, the effects of open hangar doors, the response of line-

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type heat detectors, the potential use of projected beam detectors, the possible stratification effects relative to ambient temperature, the ignitibility/ignition scenarios of JP-5 and JP-9 versus JP-4, and the effects of "water-only" overhead sprinklers on an AFFF blanket used to extinguish a jet fuel pan fire.

### Fire Sizes

The fire sizes conducted were determined based on ceiling height in relationship to detector and sprinkler response thresholds. The detector fire sizes included a 1'x1' pan (212kW), a 2'x2' pan (850kW), a 3'x3' pan (1.9 MW), and a 4'x4' (3.4 MW) pan. These were designed to measure detector sensitivity based on fire size, as well as threshold distances for optical detectors. The smaller square fire sizes were also based in part on industry standard fire sizes used in listing the optical detectors.

The sprinkler fire sizes ranged from 1.5 m diameter pan (4.5 MW) to a 15'x15' pan (45.0 MW). These were designed to measure sprinkler response thresholds based on ceiling height and fire size. The sprinkler fire sizes were designed around the following parameters:

1. Approach activation of the 175°F sprinklers.
2. Activate the 175°F sprinklers within the plume.
3. Activate the 175°F sprinklers outside the plume and approach the activation temperature of the 286°F sprinklers within the plume.

The open door tests were designed to simulate the worst case scenario for a fire in an aircraft hangar. The wood crib tests were designed to provide data for other high bay occupancies such as warehouses and nuclear storage facilities.

### Further Information

The final report should be available early in 1996. For further information, please write to Joseph E. Gott, P.E., Chief Fire Protection Engineer, Naval Facilities Engineering Command, Code 150, Alexandria, VA 22332-2300, or fax (703) 325-4450.

***In the Next SFPE Bulletin...***

The "Research Today" column will be "1995 Progress Report: Water Mist Fire Suppression System Technologies" by Gerard G. Back (Hughes Associates, Inc.)





The **Factory Mutual Research Corporation Approvals Division** has approved three new sprinklers under the Extra Large Orifice (ELO), Extended Coverage Light Hazard (ECLH), and Extended Coverage Ordinary Hazard (ECOH) classifications. Such sprinklers are for use in facilities where the protection of standard sprinklers is desired, but where the water pressure is low. Using these kinds of sprinklers may eliminate the need for a fire pump. For more information, contact, Stephen Weitzman, Loss Prevention Publications, Factory Mutual Engineering and Research, 1151 Boston-Providence Turnpike, Norwood, MA 02062.

Kudos to the **Harrington Group, Inc.**, on receiving the prestigious 1995 Engineering Excellence Honor Award from the Consulting Engineers Council of Georgia. Harrington Group was chosen for the award for its design of fire protection systems for the Cercle Theatre, located in Fantasy Harbor in Myrtle Beach, South Carolina.

Clark County, Nevada, will be the scene for the 1995 ICBO 73rd Annual Education and Code Development Conference, to be held 10-15 September. More than 1,000 building officials, building department personnel, architects and industry representatives are expected to attend. ICBO Expo 95—the 1995 Building Safety and Code Enforcement Products Exhibit—will showcase more than 75 exhibits. For more information, contact the **International Conference of Building Officials**, 5360 Workman Mill Road, Whittier, CA 90601; the telephone is 310-699-0541. A complete copy of registration materials may be requested by fax at 310-699-4253, code 4226.

Russell C. Jones is the new executive director of the **National Society of Professional Engineers**, succeeding Donald G. Weinert. Mr. Weinert is retiring after 17 years as executive director.

Congratulations to Michael Mason of **Star Sprinkler Corporation** on his appointment as director of engineering. He is a *summa cum laude* graduate in mechanical engineering of Marquette University and the University of Wisconsin, which awarded him the M.S. degree.

The Gerald L. Maatman Fellowship in Fire Protection Engineering has been established at **Worcester Polytechnic Institute** by the Kemper Foundation. Mr. Maatman recently retired as chairman and chief executive officer of the Kemper National Insurance Companies and was previously chairman of the fire protection engineering department at the Illinois Institute of Technology.