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Jury Still Out on HVLS Fans

Recent good results from tests involving sprinkler protection in conjunction with HVLS (high volume low speed) fans are at odds with some original tests that created a great deal of concern. These extra large ceiling fans are increasingly being used in warehouses and other applications for energy efficiency. The earlier test results suggested HVLS fans can present a problem to sprinklers, but more recent test results have not supported these concerns. There have been three separate series of tests to date:

2008 XL GAPS High-Piled Storage Tests

As reported in *eTechAlert* No. 118 (June 17, 2008), the first series of three full-scale wet pipe sprinkler system tests was sponsored by XL Global Asset Protection Services (XL GAPS) at Underwriters Laboratories, and involved control mode sprinkler systems. The test involved standard response 286°F K-11.2 spray sprinklers protecting 15 ft high palletized Group A plastics under a 25-ft ceiling, using the test configuration required for the listing of storage sprinklers. A 24-ft diameter ceiling fan was positioned with its outer edge over the ignition point, arranged to push air downward at a 50% power setting, and set to shut off at first sprinkler operation. The first sprinkler operated 3 minutes and twenty-six seconds (3:26) after ignition, compared to normal first-sprinkler activation in this type of test of between 47 and 90 seconds. Some seventy-three (73) ceiling sprinklers operated, far more than what would be considered acceptable, and the test was terminated after only 8 minutes.

Two other tests looked at the effect of the ceiling fans on standard response ordinary temperature rated K-5.6 spray sprinklers protecting 12 ft palletized Class II commodity. Test 2 was a baseline test without fan operation, whereas Test 3 involved a fan pushing air downward at a 50% power setting, again arranged to shut off at first sprinkler operation. In Test 2 twenty-one (21) ceiling sprinklers opened between 1:14 and 3:30 after ignition, and the fire had not reached the end of the storage array when it was terminated after 30 minutes. In Test 3 twenty-six (26) ceiling sprinklers operated between 1:57 and 3:51, and the fire did reach the end of the array.

The test series suggested that a fire in a high hazard commodity can overtax a control mode fire sprinkler system even when power to the fan is shut off at the time of first sprinkler operation. The large ceiling fans were found to continue to turn for some time after power was shut off.

2008 FPRF ESFR Tests

The Fire Protection Research Foundation effort, contracted to Schirmer Engineering, consisted of a literature search and ADD testing aimed at determining the obstruction to sprinkler discharge, as well as two full-scale tests involving ESFR protection of 20 ft rack storage of Group A plastics under a 30-ft ceiling. While the ADD tests were inconclusive, the full-scale tests offered positive results. In the first test, in which the edge of the fan

was located over the point of ignition, only 2 sprinklers operated to suppress the fire. The second test, in which the fan was centered directly above the point of ignition, operated 8 sprinklers, with the second ring sprinklers opening ahead of the sprinklers immediately over the fire. However, this was within the design capabilities of the system and considered a success.

The February 2009 report of the testing, considered the Phase I effort, is available at the nfpa.org website and contains the following conclusions within its Executive Summary:

- 1. Phase I results apply only to 30-foot high facilities with 20-foot high storage, which encompasses a significant portion of current HVLS storage and manufacturing applications.*
- 2. The minimum vertical clearance between the fan obstruction and a sprinkler deflector at ceiling level should be 3 feet as currently allowed by NFPA 13 for clearance to storage. The effects of reduced vertical clearances of the obstruction (below 3 feet) were not explored in this research effort.*
- 3. HVLS fans were consistently placed between 4 sprinklers in all full-scale tests conducted in Phase I. In an effort to build on the results presented in this report, it is recommended that HVLS fans be installed between 4 sprinklers. ADD testing was unable to definitively determine a worst-case fan placement relative to nearby sprinklers. Particle Image Velocimetry (PIV) and Phase Doppler Interferometry (PDI) techniques potentially offer a means for obtaining definitive obstruction severity data, though these approaches are currently not standardized and also require a significant investment of resources.*
- 4. The influence of fan-induced airflow on fire spread is a strong function of boundary conditions such as fan airflow (376,804 cfm used in Phase I) storage geometry, clearance from fan to storage, height of the test facility, distance to walls and the location of additional fans. In the configuration studied in Phase I, there is evidence that the storage arrangement significantly buffers the fan-induced airflow and minimizes its influence on fire spread. Based on this evidence, it was assumed that the worst-case placement of the fan relative to ignition in this configuration was directly above the latter. Further research is recommended to verify that this is indeed the worst-case placement of the fan relative to ignition. Such research could be conducted by a number of means including computational modeling [obstacles to using Fire Dynamics Simulator (FDS) noted in this report], scale modeling or additional full-scale testing.*
- 5. The fan model chosen for testing in the Phase I research effort possesses a central solidity ratio of 0.60 as illustrated in Figure 3 of this report. According to this characterization, 83% of the fan models analyzed in this report possess nearly identical or less invasive shapes than the model tested in Phase I.*
- 6. Successful system performance was achieved without fan shutoff in both full-scale tests*

2009 XL GAPS Rack Tests

During the NFPA 2009 Annual Meeting earlier this month, XL GAPS sponsored two additional fire tests at UL, this time looking at the ability of spray sprinklers to protect Group A plastic commodity in rack storage. The fire was ignited at the edge of the fan pattern, and involved one test with the racks running perpendicular to the air flow outward from the fan and one test in which the racks were positioned parallel to the air flow outward from the fan. As in the original XL GAPS tests in 2008, the sprinklers were K-11 286°F spray sprinklers used at a 0.6 gpm/sq ft density protecting 15 ft of storage under a 25 ft ceiling. Both tests were successful, with 9 sprinklers operating in the first fire test and 10 sprinklers operating in the second.

Future Testing

The mixed results have highlighted the need for additional analysis and testing. Future testing may focus attention on differences in the fans used in the various test series. The XL GAPS tests involved 4-blade fans

produced by one manufacturer, while the tests with ESFR sprinklers involved the use of 6-blade fans. There are hopes that the test that activated 73 sprinklers can be repeated using a different manufacturer's fan.

Joint ITM "Technical Tuesday" and "Business Thursday" Effort

Beginning in July of 2009, the NFSA will be sponsoring new series of "Technical Tuesday" and "Business Thursday" seminars that combine to present coordinated training aimed at helping individuals train for the work elements in the NICET Inspection and Testing certification program. As usual, ten "Technical Tuesday" online training programs will be offered for the second half of 2009, along with a series of six "Business Thursday" online seminars. What is unusual is that, for the first time ever, topics have been selected that allow a comprehensive review of both technical and nontechnical topics in the same overall subject area:

Technical Tuesdays – 2nd Half 2009

<i>Date</i>	<i>Topic</i>	<i>Instructor(s)</i>
July 21	System Terminology	V. Valentine
Aug 4	Wet Systems and Testing Preparations	J. Hugo
Aug 25	Field Identification of Sprinklers	R. Fleming
Sept 15	Basic Math	V. Valentine
Sept 29	ITM for Dry Systems	K. Isman
Oct 13	ITM for Backflow Devices	K. Wiegand
Oct 27	ITM for Hose, Hose Connections & Valves	K. Isman
Nov 10	Tank Inspections	K. Isman
Nov 24	Obstruction Inspections and Investigations	R. Fleming
Dec 8	ITM for Preaction and Deluge Systems	C. Bilbo

Business Thursdays – 2nd Half 2009

<i>Date</i>	<i>Topic</i>	<i>Instructor(s)</i>
July 30	Business & Professional Communications	R. Fleming
Aug 20	Impairment Procedures	K. Wiegand
Sept 24	Roles of the System Inspector and AHJ	R. Fleming & D. Kasmauskas
Oct 15	Inspection Contracts	M. Friedman
Nov 19	Planning and Scheduling	M. Friedman
Dec 3	Workplace Safety and the "Right to Know"	D. Bowman

NOTE: Although field personnel that might benefit from the training might not be available during hours of the original presentations, NFSA members are reminded that the seminars are accessible online for at least 24 hours following their original broadcast. Perhaps you should consider scheduling Wednesday/Friday training sessions for your personnel at your own company's convenience.

To register or for more information, contact Dawn Fitzmaurice at (845) 878-4207.

Additional training opportunities available through the NFSA engineering department include...

Two-Week Layout Technician Training

September 14-25, 2009 Baltimore, MD
October 12-23, 2009 Phoenix, AZ

Inspection and Testing for the Sprinkler Industry

July 21-23, 2009 St. Louis, MO
August 4-6 (rescheduled from June 16-18) Leominster, MA
August 18-20, 2009 Wilmington, DE

For more information on the above classes, contact Nicole Sprague using Sprague@nfsa.org or by calling 845-878-4200 ext. 149.

In-Class Training Seminars

The NFSA training department also offers in-class training on a variety of subjects at locations across the country. Here are some upcoming seminars:

Hydraulics for Fire Protection	New Lenox, IL	July 7
NFPA 13 Overview	New Lenox, IL	July 8-9
Fire Pumps for Fire Protection	Denver, CO	July 7
Fire Pump Layout & Sizing (1/2 Day)	Denver, CO	July 8
Underground Piping for Fire Protection (1/2 Day)	Denver, CO	July 8
Inspection, Testing & Maintenance	Denver, CO	July 9
CPVC Piping Installation Requirements (1/2 Day)	Denver, CO	July 21
Sprinkler Protection for Flammable & Combustible Liquids	Denver, CO	July 21
Residential Sprinklers: Homes to High Rise	Denver, CO	July 22
Sprinkler Protection for Dwellings	Denver, CO	July 23
Commissioning and Acceptance Testing (1/2 Day)	Apple Valley, CA	July 28
CPVC Piping Installation Requirements (1/2 Day)	Apple Valley, CA	July 28
Inspection, Testing & Maintenance	Apple Valley, CA	July 29
Sprinkler Protection for Rack Storage	Apple Valley, CA	July 30
Inspection, Testing & Maintenance	Lake Jackson, TX	Aug 4
Hydraulics for Fire Protection	Lake Jackson, TX	Aug 5
NFPA 13 2007 Update	Lake Jackson, TX	Aug 6
Residential Sprinklers: Homes to High Rise	Rogers, AR	Aug 11
Sprinklers for Dwellings	Rogers, AR	Aug 12
Sprinkler Prot. for Flam. & Comb. Liquid Storage (1/2 Day)	Rogers, AR	Aug 13
CPVC Piping (1/2 Day)	Rogers, AR	Aug 13
NFPA 13 Overview	Kahului, HI	Aug 12-23
Inspection, Testing & Maintenance	Kahului, HI	Aug 14
NFPA 13 Overview	Brighton, MI	Aug 19-20
Sprinklers for Dwellings	Brighton, MI	Aug 21
NFPA 13 Update 2007	Aurora, IL	Aug 26
NFPA 13 Overview	Aurora, IL	Aug 27-28
NFPA 13 2007 Update	Boardman, OR	Sept 1

Hydraulics for Fire Protection	Boardman, OR	Sept 2
Inspection, Testing & Maintenance	Boardman, OR	Sept 3
Introduction to Sprinkler Systems (1/2 Day AM)	Alexandria, MN	Sept 8
NFPA 13 2002 Update (1/2 Day PM)	Alexandria, MN	Sept 8
Plan Review Policies & Procedures	Alexandria, MN	Sept 9
Inspection, Testing & Maintenance	Alexandria, MN	Sept 10
Commissioning & Acceptance Testing (1/2 Day)	Seattle, WA	Sept 15
CPVC Piping (1/2 Day)	Seattle, WA	Sept 15
Hydraulics for Fire Protection	Seattle, WA	Sept 16
Standpipe Systems for Fire Protection (1/2 Day)	Seattle, WA	Sept 17
Fire Pump Layout & Sizing (1/2 Day)	Seattle, WA	Sept 17
NFPA 13 2007 Update	Dayton, OH	Sept 16
Sprinkles for Dwellings	Dayton, OH	Sept 17
CPVC Piping Installation Requirements (1/2 Day)	Dayton, OH	Sept 18
Commissioning and Acceptance Testing (1/2 Day)	Dayton, OH	Sept 18
NFPA 13, 13R, 13D 2007 Update	Anaheim, CA	Sept 22
Hydraulics for Fire Protection	Anaheim, CA	Sept 23
Underground Piping (1/2 Day)	Anaheim, CA	Sept 24
Basic Seismic (1/2 Day)	Anaheim, CA	Sept 24
Plan Review Policies & Procedures	Berlin, VT	Sept 22
Sprinkler Protection for Rack Storage	Berlin, VT	Sept 23
CPVC Piping (1/2 Day)	Berlin, VT	Sept 24
Basic Seismic (1/2 Day)	Berlin, VT	Sept 24
Inspection, Testing & Maintenance	Concord, NH	Oct 13
Residential Sprinklers: Homes to High Rise	Concord, NH	Oct 14
Sprinklers for Dwellings	Concord, NH	Oct 15
Underground Piping (1/2 Day)	Woodland, CA	Oct 20
Commissioning & Acceptance Testing (1/2 Day)	Woodland, CA	Oct 20
Sprinkler Protection for General Storage	Woodland, CA	Oct 21
Sprinkler Protection for Special Storage	Woodland, CA	Oct. 22
Pumps for Fire Protection	Edwardsville, IL	Oct 27
Sprinkler Protection for General Storage	Edwardsville, IL	Oct 28
Sprinkler Protection for Rack Storage	Edwardsville, IL	Oct 29
NFPA 13 Overview	Pembroke, MA	Oct 27-28
Plan Review Policies & Procedures	Pembroke, MA	Oct 29
Inspection, Testing & Maintenance	Irving, TX	Oct 27
Hydraulics for Fire Protection	Irving, TX	Oct 28
NFPA 13, 13R, 13D 2007 Update	Irving, TX	Oct 29

NFSA Tuesday eTechAlert is c. 2009 National Fire Sprinkler Association, and is distributed to NFSA members on Tuesdays for which no NFSA Technical Tuesday Online Seminar is scheduled. Statements and conclusions are based on the best judgment of the NFSA Engineering staff, and are not the official position of the NFPA or its technical committees or those of other organizations except as noted. Opinions expressed herein are not intended, and should not be relied upon, to provide professional consultation or services. Please send comments to Russell P. Fleming, P.E. fleming@nfsa.org.

About the National Fire Sprinkler Association

Established in 1905, the National Fire Sprinkler Association (NFSA) is the voice of the fire sprinkler industry. NFSA leads the drive to get life-saving and property protecting fire sprinklers into all buildings; provides support and resources for its members – fire sprinkler contractors, manufacturers and suppliers; and educates authorities having jurisdiction on fire protection issues. Headquartered in Patterson, N.Y., NFSA has regional operations offices throughout the country.

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