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NFPA 13 vs. NFPA 204

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The scope statement for the 2007 edition of NFPA 204, the Standard for Smoke and Heat Venting, contains the following excerpt:

> ". . .*The provisions of Chapters 4 through 10 shall apply to the design of venting systems for the emergency venting of products of combustion from fires in non-sprinklered, single-story buildings using both hand calculations and computer-based solution methods as provided in Chapter 9. Chapter 11 shall apply to venting in sprinklered buildings.*"

The installation of automatic smoke/heat vents in buildings provided with sprinkler protection has been controversial since the mid-1970's, if not before then.

In order to resolve some of the issues involving the installation of smoke/heat vents in sprinklered buildings, the NFPA 204 committee has developed a proposal which contains further guidance on how to properly combine the use of smoke/heat vents and sprinkler protection. Excerpts from this proposal include the following:

> "**11.2 Design Basis.** *The design of smoke and heat venting systems shall be based on a performance analysis acceptable to the AHJ.*"
>
> "**A.11.2 Design Basis.** *Design objectives for a vent system can include one or more of the following goals:*
>
> (1) *To provide occupants with a safe path of travel to a safe area*
> (2) *To facilitate manual fire fighting*
> (3) *To reduce the damage to buildings and contents due to smoke and hot gases*
>
> "**A.11.3** *Smoke and heat vents should not adversely impact the performance of the automatic sprinkler system. See NFPA 13, Section 12.1.1*"
>
> "**11.4.2** *Vents shall not operate until after sprinklers have been determined to establish control of the fire.*"

"**A.11.4.2** *Ganged vent operation is designed to simultaneously open all vents within the affected smoke zone. . .The benefit is that it may allow for enough vent area to remove the equivalent volume of smoke calculated for the design fire, whereas, the vent area from one or two individually activated vents would generally not be adequate.*

. . .For storage areas, this means that a sufficient time delay should be provided between the time of the first sprinkler actuation and the time the vents within that smoke zone are opened to allow sufficient time for both the first and second ring of sprinklers around the fire origin to operate. While the first ring of operating sprinklers is important in putting water on the fire, the second ring of operating sprinklers is important to cause pre-wetting of unburned product to thus slow or halt the advancement of the fire. This time delay will vary considerably, depending on the specific details of the stored commodities and sprinkler protection. . .

There has been no testing of ganged vent operation to verify its effectiveness. . ."

The NFPA 204 committee's substantiation for the proposal above includes the following:

"*. . .While some believe the two systems should not be used together, the reality is that some model and state codes and standards require the use of smoke/heat vents in sprinklered buildings. . .*"

The NFPA 204 committee's proposal makes reference to section 12.1.1 in the 2010 edition of NFPA 13. Section 12.1.1.1 in NFPA 13 reads as follows:

"**12.1.1.1** *Manually operated roof vents or automatic roof vents with operating elements that have a higher temperature classification than the automatic sprinklers shall be permitted.*"

The substantiation for the provisions addressing roof vents included in NFPA 13 is as follows:

"**Substantiation:** *The intent of the standard is that roof vents and draft curtains should not be used in conjunction with storage protection. Previous language was unenforceable.*"

One of the comments submitted on a negative ballot on this proposal included the following:

"**MULTER, T.:** *The following original proposal on ROP documents dated 10/20/2007 should be accepted as proposed but with a change to the annex statement.*

12.1.1 Roof Vents and Draft Curtains. Roof vents and draft curtains shall not be used in conjunction with the sprinkler protection criteria for storage in this standard.

A.12.1.1 *The design parameters in NFPA 13 were developed based upon the absence of roof vents or draft curtains. (See Annex C.6) Fire tests for sprinklers specifically listed for storage applications are tested without vents or draft curtains. References to control mode sprinklers in other building standards pertain to standard spray sprinklers that were not specifically tested by the laboratories for storage applications. With the advent of K-11.2 and larger sprinklers for storage applications and now Specific Application Control Mode sprinklers (being revised to CMSA), we need to realize that ESFRs are not the only storage sprinklers and that the use of smoke vents and draft curtains can be detrimental to all sprinklers that are specifically tested for storage applications. FM Global's recommended storage protection designs are based upon vents not being provided and that the use of automatic vents may increase the sprinkler water demand.*"

Given the above, it is apparent that the NFPA 13 committee has a different view regarding the use of automatic roof vents in sprinklered buildings than does the NFPA 204 committee. The original proposal considered by the NFPA 13 committee would have simply "flat-out" prohibited the use of roof vents and draft curtains in buildings provided with sprinkler protection. The original proposal was modified to allow the installation of roof vents , but only if manual-operated vents are provided, or if the vents are provided with fusible links with a temperature rating high enough to prevent the vents from automatically opening if the sprinkler system successfully controls the fire.[1]

While the proposal to amend NFPA 204 makes reference to the new provisions addressing the use of roof vents contained in NFPA 13, the NFPA 204 proposal does not acknowledge that the NFPA 13 provisions are a "game-changer" with respect to the capability of vents to actually perform their intended purpose. Prior to adoption of the vent provisions in NFPA 13, a proposal to recommend the "ganged" opening of multiple vents 60 seconds after sprinkler system water flow was detected was submitted Hughes Associates, Inc. on behalf of the trade association representing the smoke/heat vent manufacturers, the Smoke Vent Task Group. The rationale for this proposal was that the vents need to open early on in a fire in order for smoke/heat vents to be effective,. Obviously, the vent provisions contained in NFPA 13 are intended to prevent or substantially delay the opening of vents in a fire.

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[1] Research conducted at Underwriters Laboratories (UL) in 1997/1998 determined that the operation of standard spray sprinklers will limit the number of automatic smoke/heat vents which operate to a maximum of one where the temperature rating of the fusible elements which activates the vents is the same as the temperature rating of the sprinklers. In a number of tests conducted with both vents and sprinklers, no vents operated, including one test (Test P-2) where an automatic vent was located directly over the fire. A representative of the trade association for the smoke/heat vent manufacturers, Dr. Craig Beyler, is on record indicating that the operation of standard spray sprinklers interferes with the opening of individually-activated vents. This issue is the basis for Hughes Associates, Inc.'s proposal for the "ganged" operation of vents triggered by the activation of the water flow indicating device in the sprinkler system. See **NISTIR 6196-1**, *Sprinkler, Smoke & Heat Vent, Draft Curtain Interaction -- Large Scale Experiments and Model Development*, dated September 1998 and *Interaction of Sprinklers with Smoke and Heat Vents*, Craig L. Beyler and Leonard Y. Cooper, Hughes Associates, Inc., dated February 1999.

Analysis

The substantiation for the NFPA 204 committee proposal is "*the reality is that some model and state codes and standards require the use of smoke/heat vents in sprinklered buildings*". This statement is a reference to the requirements for the installation of smoke/heat vents in one-story industrial and storage buildings contained in the International Building Code (IBC) and International Fire Code (IFC).

Section 11.2 in NFPA 204 requires that "*the design of smoke and heat venting systems shall be based on a performance analysis acceptable to the AHJ* [authority having jurisdiction]*",* but it should be noted that neither the IBC, nor the IFC, contain a statement regarding the performance design criteria for smoke/heat vent installations. The IBC/IFC merely contain provisions stating the minimum ratio of area of vents provided to the floor area and the maximum spacing of vents. Further, the vent provisions contained in the IBC/IFC contemplate the installation of individually-activated vents, not the "ganged" operation of vents. Given this, the combination of the IBC/IFC provisions and the NFPA 204 provisions for vent installations in sprinklered buildings leads to a "dead-end". There is no performance criteria for the design of vent system installations.

Section A11.2 in Annex A of NFPA 204 suggests that vent systems in sprinkler buildings may be utilized to accomplish three separate goals. These goals are:

- "*To provide occupants with a safe path of travel to a safe area*"
- "*To facilitate manual fire fighting*"
- "*To reduce the damage to buildings and contents due to smoke and hot gases*"

Annex A provides no explanation how any of these three goals can be accomplished if the vents fail to open, either because of sprinkler activation or if insufficient heat is generated by the fire to open the vents.

It should be noted that NFPA 204 indicates that smoke/heat vents are more effective with greater temperature differentials between the smoke layer which collects under the roof of a building and the ambient temperature. NFPA 204 also indicates that the effectiveness of smoke/heat vents is compromised where the temperature differential between the smoke layer and ambient temperature is less than 110°C/198°F.

The data collected in the sprinkler/vent interaction research conducted at Underwriters Laboratories in 1997/1998 indicates that standard spray sprinklers rapidly reduce ceiling temperatures after the initial sprinkler operation. It would also be expected that the activation of in-rack sprinklers would have the same effect on ceiling temperatures as the activation of ceiling sprinklers.

Given the above, it would be expected that NFPA 204 would address the issue of the number of vents operating (opening) in buildings provided with sprinklers and the rapid reduction in ceiling temperatures caused by the activation of sprinklers. NFPA 204 does not address these two issue, other than with the recommendation that the "ganged" operation of vents be considered.

Obviously, if multiple vents do not operate, the capability of the vent system to vent smoke/heat is compromised. Similarly, if the temperature differential between the smoke layer and ambient temperature is less than 110°C/198°F, the efficiency of vents which activate is also compromised. This being the case, how can any of the three goals listed above be achieved. The NFPA 204 committee proposal does not address these two problems.

Section 11.4.2 in the NFPA 204 committee proposal indicates that "*vents shall not operate until after sprinklers have been determined to establish control of the fire.*" While commentary in Annex A explains the rationale behind this requirement, there is no explanation as to how compliance with this requirement is to be accomplished or documented. While the Fire Dynamics Simulator (FDS) is capable of predicting the activation times of multiple sprinklers, the capability of the FDS to make accurate predictions of sprinkler activation times beyond the activation time of the first sprinkler to operate has not been "validated". Given the complexity of the interaction of water droplets with the fire plume, it is simply not possible to determine activation times of multiple sprinklers at this point in time. Hence, the requirement outlined in section 11.4.2 of NFPA 204 is simply meaningless.

Section A.11.4.2 in Annex A of the NFPA 204 committee proposal suggests that the use of the concept of the "ganged" operation of smoke/heat vents be considered for vent systems in building provided with sprinkler protection. This section in Annex A will also include the statement that *"there has been no testing of ganged vent operation to verify its effectiveness. . ."* It seems rather strange that the NFPA 204 committee would recommend that the concept of the "ganged" operation of smoke/heat vents be considered, but then state that "*there has been no testing of*" this concept to confirm that it will actually work. Without extensive testing of the concept of the "ganged" operation of multiple smoke/heat vents, how can the NFPA 204 committee recommend that this concept be utilized, much less considered?

Given all of the above, it is not too difficult to conclude that the NFPA 204 committee's proposal for addressing the use of roof vent systems in buildings provided with sprinkler protection has not been well thought-out. With all of the flaws in the proposal submitted by the committee, it only seems rational that this proposal should be rejected by the NFPA membership.

On April 7, 2011, a Notice of Intent to Make a Motion (NITMAM) regarding the NFPA 204 committee's proposal for addressing the use of smoke/heat vents in sprinklered buildings was filed with the NFPA. This NITMAM will request that Comment 204-6 Log #14 be accepted. This comment proposes that Chapter 11 in NFPA 204 be deleted in its entirety.

Debate on the NITMAM submitted for NFPA 204 will occur at the technical meeting at the NFPA Annual Meeting to be held in Boston on June 14-15, 2011.

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